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ABSTRACT

This guide provides information to enable coordinators to direct learning activities for students using an individualized study guide on being a welder's helper. The study material is designed for students enrolled in cooperative part-time training and employed, or desiring to be employed, as welders' helpers. Contents include a sample progress chart, suggested teaching procedures for the coordinators, answers to assignment sheets, answers to a unit test, a sheet with the study guide objective and specific objectives, 19 information sheets, 19 assignment sheets, 40 transparency masters, and a six-part unit test. The information sheets cover these topics: history and safety, equipment, welding flames, selecting welding tips, cutting torch terminology, the cutting torch, the cutting process, selecting cutting tips, history and terminology of arc welding, the arc welder and equipment, arc welding safety, electrode, welding terminology, weld types, introduction to MIG welding, introduction to TIG welding, equipment, definitions and identification, and safety rules and practices. (YLB)

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Individualized Study Guide

GENERAL METAL TRADES

WELDER'S HELPER

Coordinator's Guide

Prepared by James W. Dean

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WELDER'S HELPER

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FOREWORD

This individualized study guide has been developed for the student who is enrolled in Cooperative Part-time Training and who is employed or desires to be employed as a welder's helper. The study material is designed to provide the student with general information for immediate reinforcement on the job and to develop an understanding of the job prior to employment.

Even though these study guides are individualized, the coordinator should closely supervise each student's studies. To allow the coordinator to better direct the learning activities, both coordinator guides and student manuals are available. A progress chart provided in each student manual will allow the coordinator to pinpoint the progress a student has made toward each objective in the sequence in which they are completed.

Appreciation is expressed to those whose expertise made possible the development of these study guides. The assistance of these instructors in the development process assures that the materials are current of use to vocational teachers in Texas. The following instructors provided valuable assistance in the developmental process:

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Bill Barnes, PhD., Director
Occupational Curriculum Laboratory

Progress Chart for

WELDER'S HELPER

Name ______________________________

School ______________________________

		Date Completed
INFORMATION SHEET 1	HISTORY AND SAFETY	
ASSIGNMENT SHEET 1	HISTORY AND SAFETY	
Test	Part 1	
Objective	Discuss briefly the history of oxyacetylene welding, and explain the safety rules to be followed when using oxyacetylene in welding.	
INFORMATION SHEET 2	EQUIPMENT	
ASSIGNMENT SHEET 2	OXYACETYLENE WELDING EQUIPMENT	
Test	Part 2	
Objective	Identify oxyacetylene welding equipment.	
INFORMATION SHEET 3	WELDING FLAMES	
ASSIGNMENT SHEET 3	OXYACETYLENE FLAMES	
Test	Part 3	
Objective	Recognize the proper flames for oxyacetylene welding.	
INFORMATION SHEET 4	SELECTING WELDING TIPS	
ASSIGNMENT SHEET 4	SELECTING WELDING TIPS	
Test	Part 4	
Objective	Select the proper welding tips for oxyacetylene welding.	

		Date Completed
INFORMATION SHEET 5	CUTTING TORCH TERMINOLOGY	
ASSIGNMENT SHEET 1	CUTTING TORCH TERMINOLOGY	
Test	Part 5	
Objective	Select the correct terminology to be used when using the cutting torch.	
INFORMATION SHEET 6	THE CUTTING TORCH	
ASSIGNMENT SHEET 2	THE CUTTING TORCH	
Test	Part 6	
Objective	Identify the different parts of the cutting torch	
INFORMATION SHEET 7	THE CUTTING PROCESS	
ASSIGNMENT SHEET 7	THE CUTTING PROCESS	
Test	Part 7	
Objective	Point out the hazards one might meet, and the reasons for poor torch cuts.	
INFORMATION SHEET 8	SELECTING CUTTING TIPS	
ASSIGNMENT SHEET 8	SELECTING CUTTING TIPS	
Test	Part 8	
Objective	Select the proper cutting tips to be used when cutting	
INFORMATION SHEET 9	HISTORY AND TERMINOLOGY OF ARC WELDING	
ASSIGNMENT SHEET 9	HISTORY AND TERMINOLOGY OF ARC WELDING	
Test	Part 9	
Objective	Discuss briefly the history and terminology related to shielded metal arc welding.	

		Date Completed
INFORMATION SHEET 10	THE ARC WELDER AND EQUIPMENT	
ASSIGNMENT SHEET 10	THE ARC WELDER AND EQUIPMENT	
Test	Part 10	
Objective	List the types of arc welders and arc welding equipment.	
INFORMATION SHEET 11	ARC WELDING SAFETY	
ASSIGNMENT SHEET 11	ARC WELDING SAFETY	
Test	Part 11	
Objective	Point out the safety rules that are related to metal arc welding.	
INFORMATION SHEET 12	THE ELECTRODE	
ASSIGNMENT SHEET 12	THE ELECTRODE	
Test	Part 12	
Objective	List the basic types of electrodes, and point out other information related to electrodes.	
INFORMATION SHEET 13	WELDING TERMINOLOGY	
ASSIGNMENT SHEET 13	WELDING TERMINOLOGY	
Test	Part 13	
Objective	Select the correct terminology to be used when working with shielded metal arc welding.	
INFORMATION SHEET 14	WELD TYPES	
ASSIGNMENT SHEET 14	WELD TYPES	
Test	Part 14	
Objective	Explain the four weld types used in shielded metal arc welding.	

		Date Completed
INFORMATION SHEET 15	INTRODUCTION TO MIG WELDING	
ASSIGNMENT SHEET 15	INTRODUCTION TO MIG WELDING	
Test	Part 15	
Objective	Select the correct terminology to be used in MIG welding, and point out the advantages of MIG welding.	
INFORMATION SHEET 16	INTRODUCTION	
ASSIGNMENT SHEET 16	INTRODUCTION	
Test	Part 16	
Objective	Select the correct terminology, the advantages, and the metals which can be welded by the TIG process	
INFORMATION SHEET 17	EQUIPMENT	
ASSIGNMENT SHEET 17	EQUIPMENT	
Test	Part 17	
Objective	Identify the equipment and how it is used in TIG welding.	
INFORMATION SHEET 18	DEFINITIONS AND IDENTIFICATION	
ASSIGNMENT SHEET 18	DEFINITIONS AND IDENTIFICATION	
Test	Part 18	
Objective	Point out the different types of shop equipment, and explain how each is used.	
INFORMATION SHEET 19	SAFETY RULES AND PRACTICES	
ASSIGNMENT SHEET 19	SAFETY RULES AND PRACTICES	
Test	Part 19	
Objective	Identify the correct safety practices to be followed while working with shop tools as a welder's helper.	

This student has completed the indicated training under my supervision.

x Teacher ____________________

WELDER'S HELPER

SUGGESTED TEACHING PROCEDURES FOR THE COORDINATOR

I. Objective sheet

A. Discuss each objective with the student.

B. Explain the relationship of each objective to the student's training station

C. Have the student complete the objectives in the most logical sequence for the training station.

(NOTE: A change of sequence is necessary only if a student changes jobs during the year or an employer requests training in a specific area).

D. Add any objectives necessary for the training station.

II. Information and assignment sheets.

A. INFORMATION SHEET 1--HISTORY AND SAFETY

1. The first part of this information sheet may be used to give an overview of oxygen and acetylene welding.

2. Discuss each safety rule in detail.

3. Add any safety rules that fit your particular situation.

4. Secure safety posters and films for class use.

5. Use the transparency masters included in this unit to reinforce the safety practices used by a welder helper.

6. Use ASSIGNMENT SHEET 1--HISTORY AND SAFETY to reinforce this area of information.

a. Have the student's employer explain the safety rules and their importance to the operation.

B. INFORMATION SHEET 2--EQUIPMENT

1. This information may be used to help the student identify the common pieces of equipment found in the shop and on the welding truck pertaining to oxyacetylene welding.

2. Use the transparency masters included in this unit pertaining to the equipment and discuss them with the student.

3. Use ASSIGNMENT SHEET 2--OXYACETYLENE WELDING EQUIPMENT to reinforce this area of information.

   a. Have the student's employer identify each piece of equipment used in their business.

   b. Have the student make a list of the oxyacetylene equipment used by their employer. Include in this list the brand name, why this particular brand, and the number(s) of each piece of equipment.

   c. Have the student's employer show the student how to correctly use the equipment.

C. INFORMATION SHEET 3--WELDING FLAMES

1. This information may be used to help the student identify the types of welding flames used for oxyacetylene welding.

2. Use the transparency masters included in this unit pertaining to the flames and discuss where and why each should be used.

3. Use ASSIGNMENT SHEET 3--OXYACETYLENE FLAMES to reinforce this area of information.

   a. Have the student's employer show the student how to correctly light and adjust the different welding flames.

   b. Have the student's employer explain what type of oxyacetylene welding each flame is used for.

D. INFORMATION SHEET 4--SELECTING WELDING TIPS

1. This information may be used to help the student select the correct welding tip for a particular job.

2. Discuss the chart on welding tips compared to metal thickness thoroughly.

3. Use the transparency masters included in this unit pertaining to welding tips and discuss them with the student.

4. Use ASSIGNMENT SHEET 4--SELECTING WELDING TIPS to reinforce the area of information.

   a. Have the student go to the local welding supply distributor and obtain different charts on selecting welding tips.

   b. Have the student's employer explain how tips are selected for different welding jobs.

E. INFORMATION SHEET 5--CUTTING TORCH TERMINOLOGY

1. This information may be used as a glossary. Discuss each term thoroughly with the student.

2. Add any additional terms that fit your particular situation.

3. Use ASSIGNMENT SHEET 1--CUTTING TORCH TERMINOLOGY to reinforce this area of information.

   a. Have the student's employer discuss the terms and their relationship to the job of welder's helper.

F. INFORMATION SHEET 6--THE CUTTING TORCH

1. This information may be used to help the student identify the parts of the cutting torch.

2. Use the transparency masters included in this unit pertaining to the cutting equipment and discuss them with the student.

3. Use ASSIGNMENT SHEET 2--THE CUTTING TORCH to reinforce this area of information.

   a. Have the student's employer identify the cutting equipment used in their business.

   b. Have the student's employer show the student how to correctly use the equipment.

G. INFORMATION SHEET 7--THE CUTTING PROCESS

1. This information may be used to call to the attention of the student the needs to work safely when cutting metal.

2. Use the transparency master included in this unit pertaining to poor cuts and discuss it thoroughly with the student.

3. Have students bring in small samples of oxyacetylene cutting and discuss the correctness or incorrectness of cut on each sample.

4. Use ASSIGNMENT SHEET 7--THE CUTTING PROCESS to reinforce this area of information.

   a. Have student's employer show the student how to correctly make straight and bevel cuts with the oxyacetylene cutting torch.

   b. Have student's employer show the student what their expectations are for correct cuts.

   c. Have student's employer point out the do's and do not's when cutting metal with the oxyacetylene cutting torch.

   d. Have student's employer show the student how to properly set up and shut down the oxyacetylene.

H. INFORMATION SHEET 8--SELECTING CUTTING TIPS

1. This information may be used to help the student to select the correct cutting tip for a particular job.

2. Use the transparency master included in this unit pertaining to cutting tips and discuss it thoroughly with the student.

3. Have the student go to the local welding supply distributor and pick up a welding and cutting guide for the brand of equipment being used at the work station. Show the student how to use it.

4. Use ASSIGNMENT SHEET 8--SELECTING CUTTING TIPS to reinforce this area of information.

    a. Have student's employer explain how to select cutting tips for different jobs and metal thickness.

    b. Have student's employer show the student how to correctly install the cutting tips in the cutting torch attachment.

I. INFORMATION SHEET 9--HISTORY AND TERMINOLOGY OF ARC WELDING

1. This information may be used as a glossary. Discuss each term thoroughly with the student.

2. Add any additional terms that fit your particular situation.

3. Use ASSIGNMENT SHEET 9--HISTORY AND TERMINOLOGY OF ARC WELDING to reinforce this area of information.

    a. Have the student's employer discuss the terms and their relationship to the job of welder's helper.

J. INFORMATION SHEET 10-THE ARC WELDER AND EQUIPMENT

1. This information may be used to help the student identify the machines and equipment used for arc welding with electrodes.

2. Use the transparency masters included in this unit pertaining to the arc welding machines and equipment and discuss them with the student.

3. Use ASSIGNMENT SHEET 10-THE ARC WELDER AND EQUIPMENT to reinforce this area of information.

    a. Have the student's employer identify the arc welding machines and equipment used in their business.

    b. Have the student's employer show the student how to correctly use the equipment.

4. Take the student to a local distibutor of arc welding machines and equipment to observe the different types of arc welding machines and equipment stocked for welders.

K. INFORMATION SHEET 11-ARC WELDING SAFETY

1. This information may be used to call to the attention of the student the need to work safely around and with arc welding machines and equipment.

2. Use the transparency masters included in this unit pertaining to safety dealing with arc welding and discuss these thoroughly with the student.

3. Secure safety posters and films for class use.

4. Add any safety rules that fit your particular situation.

5. Use ASSIGNMENT SHEET 11-ARC WELDING SAFETY to reinforce this area of instruction.

   a. Have the student's employer explain the safety rules and their importance to the operation.

L. INFORMATION SHEET 12-THE ELECTRODE

1. This information may be used to help the student identify the common electrodes used in the shop and on the portable welding truck.

2. Discuss in detail the transparency master on electrode classification included in this unit with the student.

3. Have the student go to a local arc welding supply distributor and pick-up a pocket guide on electrodes for his own personal use.

4. Use ASSIGNMENT SHEET 12-THE ELECTRODE to reinforce this area of instruction.

   a. Have student pick up and bring to class an assortment of electrodes used by the employer and discuss the types and classification number of each.

   b. Have student's employer explain where and why he uses particular electrodes that are stocked in the shop and on the portable welding truck.

M. INFORMATION SHEET 13-WELDING TERMINOLOGY

1. This information may be used as an addition to the glossary of terms in INFORMATION SHEET 1. Discuss each term thoroughly with the student.

2. Add any additional terms that fit your particular situation.

3. Use the transparency masters included in this unit pertaining to welding terminology and discuss them with the student.

4. Use ASSIGNMENT SHEET 13 -WELDING TERMINOLOGY to reinforce this area of instruction.

   a. Have student's employer explain where and why the different positions for arc welding are used.

   b. Have the student's employer show the student how to identify and prepare the different weld joints.

5. Take the student to a local metal fabricating business and observe the arc welding safety and practices being used by the firm.

E. INFORMATION SHEET 14 -WELD TYPES

1. This information may be used to help the student identify the different weld types.

2. Use the transparency master included in this unit pertaining to weld types and discuss it thoroughly with the student.

3. Use ASSIGNMENT SHEET 14 -WELD TYPES to reinforce this area of information.

   a. Have student's employer explain why and where the different weld types are used in the work.

   b. If possible, have student bring in small samples of different weld types from the training station.

M. INFORMATION SHEET 15--INTRODUCTION TO MIG WELDING

1. This information sheet may be used to give a basic overview of MIG welding. Discuss the terms thoroughly with the student.

2. Using the transparency masters provided in this unit, explain the MIG welding process and its advantages.

3. Secure film on MIG welding and show it to the student to reinforce the information in this unit.

4. Use ASSIGNMENT SHEET 15-INTRODUCTION TO MIG WELDING to reinforce this area of information.

   a. Have the student's employer explain the operation of the MIG equipment used in the business.

   b. Have the student's employer show the student how to correctly service, maintain and make basic ajustments of the MIG equipment upon instructions from the welder.

N. INFORMATION SHEET 16-INTRODUCTION

1. Discuss the terms used in TIG welding thoroughly with the student.

2. Using the transparency masters provided in this unit, explain the TIG welding process.

3. Discuss the advantages of the TIG process and compare TIG to MIG welding.

4. Use ASSIGNMENT SHEET 16-INTRODUCTION to reinforce this area of information.

    a. Have the student's employer explain the operation and welding process of the TIG equipment used in his business.

O. INFORMATION SHEET 17-EQUIPMENT

1. Discuss the equipment used in TIG welding thoroughly with the student.

2. Using the transparency masters included in this unit; explain the operation of the torch and flowmeter, selection of shielding gases, and selection of and types of cups and electrodes.

3. Use ASSIGNMENT SHEET 17-EQUIPMNENT to reinforce this area of information.

    a. Have the student's employer show the student how to correctly service, maintain, and make basic adjustments of the TIG equipment upon instructions from the welder.

P. INFORMATION SHEET 18-DEFINITIONS AND IDENTIFICATION

1. Using the transparency master included in this unit, discuss each piece of equipment thoroughly with the student.

2. Add any additional piece of equipment that may be used in the student's training station.

3. Use ASSIGNMENT SHEET 18-DEFINITIONS AND IDENTIFICATION to reinforce this area of information.

    a. Have the student's employer identify each piece of equipment used in their business.

    b. Have the student make a list of the shop equipment used by their employer. Include in this list, the brand name, why this particular brand, and number(s) of each piece of equipment.

    c. Have the student's employer show the student how to correctly use the equipment.

4. Add any safety rules that fit your particular situation.

5. Use ASSIGNMENT SHEET 19--SAFETY RULES AND PRACTICES to reinforce this area of information.

    a. Have the student's employer explain the safety rules and their importance to the operation.

Q. INFORMATION SHEET 19--SAFETY RULES AND PRACTICES

1. Discuss each safety rule in detail with the student.

2. Use the transparency masters included in this unit to reinforce the safety practices involving the shop equipment.

3. Secure safety posters and films for class use.

III. Answers to Assignment Sheets

A. Some of the assignment sheets will vary according to training and should be graded individually.

B. Some assignment sheets will not have specifics but will depend on student participation.

IV. Unit Test

A. Answers are based on total information covered in the unit.

B. The test is divided into two parts and various ways may be used in evaluation.

1. Give each part of the evaluation after the student has completed studying the information on one or more information and assignment sheets.

2. Give the entire test upon completion of all the information and assignment sheets.

C. Include evaluation parts corresponding to any information area or sheets added to the unit.

V. References

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WELDER'S HELPER

ANSWERS TO ASSIGNMENT SHEETS

ASSIGNMENT SHEET 1

A. Produced by mixing calcium carbide with water.

B. Oxygen greatly accelerates (speeds up) combustion.

C.
1. Cylinders should be secured in an upright position to a wall or dolly so they cannot be knocked over.
2. Acetylene cylinders should never be placed and used on their side since the acetylene is dissolved in acetone which will be drawn out with the acetylene when the cylinder is lying down.
3. Stop welding when the torch is burning with a purple flame. This indicates that the acetone is being drawn out.
4. Do not handle welding equipment with oily gloves, and do not oil the regulators.
5. Remove dust and dirt from the valve openings by slightly opening and quickly closing cylinder valves before attaching a regulator.
6. Release the adjusting screw on the regulator before opening the cylinder valve so that no damage will occur to the regulator or injury to the operator.
7. Stand to one side of the regulator when opening the cylinder valve.
8. Open valves very slowly on cylinders.
9. Never use free-flowing acetylene at pressures above 15 PSI since it is very unstable.
10. Check every few days for leaks in hoses and fittings, using soapy water.
11. Purge lines separately before lighting the torch so that gas mixtures in lines will not cause flashback.
12. Have safety clothing and protection in place before lighting the torch.
13. Always light the acetylene before opening the oxygen on the torch.
14. Make sure that no person or any flammable material is in the direction of the flame when lighting and using the torch.

15. Do not use the oxygen in the torch to cool yourself because the oxygen will support combustion of materials that are usually not combustible.

    (NOTE: This could cause your clothes to burn rapidly if you caught on fire.)

16. Know how to use fire extinguishers in the shop.

17. Open the acetylene cylinder valve no more than one and one-half turn so that it may be shut off quickly in case of a fire.

18. Avoid welding materials that give off combustion or toxic fumes.

19. Provide adequate ventilation in welding areas.

20. Close main cylinder valves when the oxyacetylene unit is not to be in use for long periods of time.

21. Follow manufaturer's instructions when working with or shutting down the welding or cutting equipment.

22. Remove extra or empty cylinders from the welding area and building when possible. (Tag cylinders as empty)

23. Place steel caps on all cylinders when transporting or storing them.

24. Keep welding area neat and free from extra materials.

25. Avoid handling hot metal with gloves. Use pliers.

26. Use snug-fitting wrenches when installing or removing regulators.

ASSIGNMENT SHEET 2

A. a. Left-hand (female) threads
   b. Leaded plugs
   c. Absorptive material
   D. Valve wrench
   e. Single seated valve
   f. Leaded plugs

B. a. Double-seated valve
   b. Safety fuse plug and disk
   c. Handwheel
   d. Right-hand (male) threads

C. 1. A
   2. B

D. a. Flint lighter
   b. Goggles
   c. Tip cleaner
   d. Fire brick table
   e. gloves

ASSIGNMENT SHEET 3

1. Carburizing
2. Neutral
3. Oxidizing

ASSIGNMENT SHEET 4

I. A. 8
   B. 7
   C. 5
   D. 6
   E. 0
   F. 00
   G. 3
   H. 1

II. A. 1/1
   B. 7/7
   C. 4/4
   D. 8/8
   E. 2/2
   F. 1/1
   G. 3/3
   H. 1/1

WELDER'S HELPER

ANSWERS TO ASSIGNMENT SHEETS

ASSIGNMENT SHEET 5

A. Flame cutting
B. Oxidizing
C. Slag
D. Oxides
E. Kerf
F. Drag line
G. Flashback
H. Backfire
I. Preheat time
J. Preheat orifice
K. Tip cleaner

ASSIGNMENT SHEET 6

A. Cutting tip
B. Oxygen pre-heat valve
C. Cutting oxygen lever
D. Torch body
E. Acetylene torch valve
F. Oxygen torch valve

ASSIGNMENT SHEET 7

I. A. Will cause burns to body
  B. Will burn hoses
  C. Causes fires in clothing
  D. Forms sharp edges on cut metal
  E. Will cause concrete to explode

II. A. Acetylene or oxygen pressure too low
  B. Cutting tip nut loose
  C. Slag or splatter on tip
  D. Overheating the cutting tip
  E. Faulty o-rings
  F. Rust or dirt on metal being cut

III. A. Flame momentarily burns inside tip
  B. There is usually a loud pop
  C. The flame sometimes goes out

D. The flame may continue to burn normally.

IV. A. A fire burining inside the torch

B. The flame seems to go out

C. A squealing or hissing noise begins

D. Torch starts smoking and getting hot

E. Torch will burn in half if flashback continues

V. A. 8

B. 7

C. 6

D. 1

E. 4

F. 3

G. 2

H. 5

ASSIGNMENT SHEET 8

I. A. Diameter

B. 000 to 8

C. Cutting orifice

D. Preheat

E. Thickness

F. Increases

G. Small

H. Large

II. A. Bevel

B. Straight

III. 0, 000, 4, 1, 00, 3, 2

UNIT III

INTRODUCTION TO SHIELDED ARC WELDING

ANSWERS TO ASSIGNMENT SHEETS

ASSIGNMENT SHEET 9

I. A. Shielded metal arc welding
B. Arc
C. Electrode
D. Flux
E. Base metal
F. Filler metal
G. Deposited metal
H. Crater
I. Arc length
J. AC welder
K. DC welder
L. Amperage
M. AWS

II. History

A. Welding with an electric arc was developed at the end of the 19th century

B. Electric arc welding was first used in 1881 by a French inventor to join parts of a storage battery

C. Introduction of arc welding in the U.S. failed because people were not aware of the possibilities

D. Carbon arc welding was patented in 1887 by a Russian inventor

E. Coated welding rods were introduced in 1929

F. Coatings were improved to keep out oxygen and nitrogen and form a stronger weld

ASSIGNMENT SHEET 10

I. A. AC welder
B. DC welder
C. AC-DC welder

II. A. F
B. T
C. F
D. F

III. A. Cutting can be done with special rods

B. Hole piercing

C. Gouging or removing metal

D. Beveling metal edges

IV. A.	Helment	D.	Filter lens
B.	Clear plastic lens	E.	Clean plastic lens
C.	Rubber gasket	F.	Hold down clamp

ASSIGNMENT SHEET 11

I. A. Properly ground the arc welder

B. Keep the welder in a cool, dry location

C. Do not leave cables where thay can be run over by other equipment or machinery

D. When welding, do not stand on wet surfaces or in water

E. Use electrode holders that are well insulated and free from cracks

F. Wear leather gloves that are in good condition

II. A. The face and eyes should be covered with an arc welding helmet or shield

B. Any exposed skin surface should be covered to prevent burns from the ultraviolet and infrared rays

C. A verbal warning should be given to all persons in the area before striking an arc

D. Examine the helmet for cracks that will allow light to enter

E. Replace any cracked helmet lens

F. Do not wear oxyacetylene goggles when arc welding

III. A. Wear high-top shoes

B. Do not wear pants with cuffs

C. Shirts should have long sleeves and button-up collars

D. Wear welding gloves of leather

E. Leather welding sleeves should be worn when available

F. Leather aprons should be worn when available

G. Safety glasses should be worn when chipping or cleaning the weld

IV. A. Toxic gases are formed when welding galvanized metal

B. Fans or adequate ventilation should be used to eliminate these gases

C. Avoid welding on containers of metal that have contained chemicals or been painted

V. A. Remove all oily rags or greasy materials from the welding area

B. Do not weld on containers that have held a combustable substance

VI. A. Handle hot metal with pliers

B. Stand to one side when dropping hot metal into a cooling vat because hot steam will be given off

C. Molten metal splatter from welding can cause serious burns if skin is not properly protected

ASSIGNMENT SHEET 12

I. A. E stands for electrodes for electric arc welding

B. The first two digits of a four-digit number or the first three digits of a five-digit number represents the tensil strength of the deposited metal

1. 60 would indicate a minimum of 60,000 PSI tensil strenth

2. 100 would indicate minimum of 100,000 PSI tensil strength

C. The third digit of a four-digit number or the fourth digit of a five-digit number indicates the welding position

1. A number 1 here indicates all positions

2. A number 2 here indicates flat positions only

(NOTE: horizontal or downhand)

D. The fourth digit of a four-digit number or the fifth digit of a five-digit number digit indicates special characteristics of the electrode

(NOTE: Refer to a pocket guide for specifications)

1. Current used

a. AC b. DC straight c. DC reverse

2. Type of flux coating

3. Penetration

III. A. Diameter

B. 5/16

C. 3/32, 5/32, 7/32

IV. A. Keeps air out of the molten puddle

B. Allows weld to cool more slowly, which makes the weld stronger

C. Removes impurities from weld puddle

D. Stabilizes the arc

E. Prevents porousness of weld metal

F. Adds alloys to weld metal for strength

G. Allows a faster deposit rate

H. Permits better penetration

ASSIGNMENT SHEET 13

I. A. Flat

B. Horizontal

C. Vertical

D. Overhead

II. A. Butt

B. Tee

C. Corner

D. Lap

E. Edge

III. A. Weld

B. Slag

C. Gaseous shield

D. Angle of electrode

E. Electrode

F. Flux coating

G. Wire core

H. Arc length

I. Crater

J. Penetration

K. Base metal

ASSIGNMENT SHEET 14

I. A. Surfacing weld--Made up of one or more stringer or weave beads deposited on an unbroken surface to obtain desired properties or dimensions.

(EXAMPLE: Metal deposited for hardfacing or to buildup a worn part)

B. Fillet weld--Joins two pieces of metal at right angles of each other such as in a T, corner or lap joint. Weld is approximately a triangle in cross section.

C. Groove weld--Weld made in a groove between two pieces of metal.

D. Plug and slot weld--Used to join two overlapping pieces of metal through circular holes or slots. Sometimes used instead of riveting the pieces together.

ASSIGNMENT SHEET 15

I. A. Gases used to replace the air around the arc to prevent oxidation and contamination.

B. Usually direct current reverse polarity, with the electrode (wire) positive and the work negative.

C. An abreviation used for Metal Inert Gas Welding.

D. The distance the wire sticks out past the contact tip of the gun.

II. A. Only a small amount of spatter and no slag are produced.

B. Faster welding rates are possible.

C. Different metal thicknesses may be welded without changing wire size.

D. Gaps and badly fitting joints may be filled easily without burning through.

E. Metal distortion is reduced.

F. Most alloys may be welded by choosing the correct filler wire and shielding gas.

G. Narrower beveled joint design may be used because of deep penetrating characteristics.

III. A. Short arc

B. Spray arc

C. Flux-cored wire

IV. A. Alloy of metal to be welded

B. Metal thickness

C. Design of weld joint

D. Job specifications

V. Solid

Flux-cored

VI. A. Argon

B. Helium

C. CO_2--Carbon dioxide

VII. A. The amount of shielding gas supplied at the weld is controlled by a gas flow meter.

B. The flow rate is measured in cubic feet per hour (CFH).

C. The flow meter is adjusted to provide the proper amount of shielding gas for the thickness of metal being welded.

WELDER'S HELPER

ANSWERS TO ASSIGNMENT SHEETS

ASSIGNMENT SHEET 16

I. A. A gas used to keep oxygen, nitrogen, or impurities out of the weld area.

B. Identifies the type of welding being done.

C. An abbreviation used for Tungsten Inert Gas welding.

D. Describes the process of removing the air or other matter from the weld area.

E. An arc welding process using a non-consumable electrode to produce an arc shielded by a gas.

F. Identifies the metal in the non-consummable electrode which carries current to produce the arc.

G. A thin coating on aluminum that is caused by oxygen mixing with the surface of the metal.

II. A. Very little spatter and slag are produced.

B. No flux is required.

C. Little cleaning is required after the weld is made.

(NOTE: Air is kept away from the molten metal by the inert shielding gas).

D. The weld is usually stronger than the metal being welded because it is kept pure by the shielding gas.

E. Welding can easily be done in all positions.

(NOTE: This is because there is no flux or slag).

F. The weld area can easily be seen.

G. The metal does not warp because the weld heat is directed to a small area.

III. A. Aluminum

B. Magnesium

C. Stainless steel

D. Nickel

E. Copper

F. Brass

G. Carbon and low alloy steel

ASSIGNMENT SHEET 17

I. A. AC, DC

B. Machine, foot

C. Fine

D. Solenoid

E. After flow

II. A. Provides a handle

B. Holds the electrode

C. Carries gas to the arc

D. Carries electricity to the arc

E. Carries water to cool the torch head

III. A. Holds all other parts together

B. Holds collet in place

C. Holds electrode

D. Tightens collet on electrode

E. Directs shielding gas around electrode and to the weld area.

IV. A. Regulates flow of gas in cubic feet per hour (CFH).

B. Indicates pressure in the gas cylinder in pounds per square inch (PSI).

C. Has a flow scale to indicate the amount of gas flowing for different types of gases used for welding various metals.

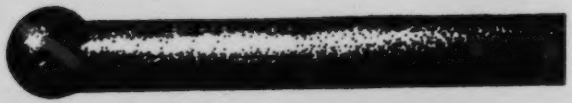
D. Reduces high cylinder pressure to a lower working pressure.

V. 330, 3000

VI. Lengths: 3"; 6"; 7"; 18"; 24"

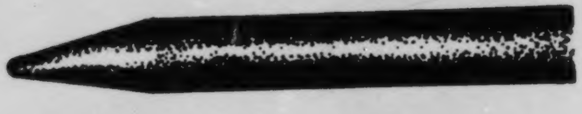
Diameters: .010"; .020"; .040"; 1/16"; 3/32"; 1/8"; 5/32"; 3/16"; 1/4"

VII. A.



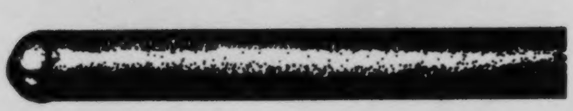
For AC

B.



For DCSP

C.



For DCRP

VIII. A. Ceramic--With air-cooled torches up to 250-300 amps. flow.

Metal--With water-cooled torches

B. type, size, diameter

UNIT VI

SHOP EQUIPMENT AND TOOLS

ANSWERS TO ASSIGNMENT SHEETS

ASSIGNMENT SHEET 18

I. Shop Equipment

A. Hand Grinder--Used for portable rough grinding. Wire cup brush can be installed and used for removal of paint, rust, scale and slag from welds

B. Pedestal Grinder--Used for stationary rough grinding

C. Bench Grinder--Used for tool sharpening and/or fine grinding

D. Drill press--Used for drilling holes, reaming, countersinking, counterboring and tapping

E. Portable power shear--Hand-held portable electric-powered shear used for straight or circular cutting of thin metals (gage metal)

F. Squaring shear--Foot-operated stationary shear used for squaring or triming large sheets of metal

G. Ironworker--Used for shearing (cutting off) flat, angle, round, square, hex and octagon shaped metal stock to length; will also punch holes and cut notches

H. Abrasive cutoff saw--Used to cut metal stocks to length by using a thin revolving abrasive wheel

I. Bandsaw--Used to cut metal stock to length with a continuous saw blade

J. Power Hacksaw--Used for cutting metal stock to length using a reciprocating (back and forth) movement of the saw blade.

ASSIGNMENT SHEET 19

I. Safety

A. Grinders

1. Always wear goggles, safety glasses, or an eye shield when performing any grinding operation and while working.

2. Stand to the side of the grinding machine when it is first turned on and until it reaches operating speed.

3. Never put a wheel on the grinder before checking it

for cracks.

4. Keep guards and shields in place and securely fastened.

5. Keep your hands clear of the rotating grinding wheel. Hold small pieces with pliers when grinding.

6. Always stop the machine before making measurements or adjustments.

7. Make sure that the tool rest is properly adjusted. Adjust to within 1/16-1/18" of the grinding wheel.

8. Never leave a grinder running unattended.

B. Drill Press

1. Do not operate the machine unless all guards are in place and secured.

2. Do not attempt to stop a revolving piece of stock in which the drill is caught. Turn off the power and then free the piece.

3. Relieve pressure on the drill just before it breaks through the work to prevent it from binding, causing the work to rotate or break the twist drill.

4. Clamp all work solidly with the proper device.

5. Use only straight and sharp twist drills.

6. Always stop the drill press before making adjustments or measurements.

7. Clean chips from the work and work area with a brush, not your hands.

8. Always remove the chuck key from the chuck before turning on the drill.

9. Wipe up all cutting fluid that spills on the floor. Use a piece of cotton waste or rag and be careful of chips.

10. Always wear goggles, safety glasses or an eye shield when performing any drilling operations and while working in the shop.

C. Shears

1. Always wear goggles, safety glasses or an eye shield when using a manual or power shears and while working in the shop.

2. Keep the work area clean of small pieces of metal. Place scrap pieces in the scrap box or barrel.

3. Keep fingers away from the blade on the squaring shear. All guards should be in place and secure.

4. Do not run your hands over the edge of the metal that has just been cut. Painful cuts can be received from the burrs.

5. Sheet and plate metal can cause serious cuts. Handle with care. Wear gloves whenever possible.

6. Treat every cut immediately, no matter how minor.

7. Get help when cutting large pieces of sheet and plate metal. Keep everyone clear of shear when you are making the cut.

8. Protect your feet when using the foot pedal of the squaring shear and falling pieces of metal after shearing. A serious and painful foot injury will result if one is not careful.

9. When using portable shears, keep the cord from binding or being cut by the metal edge. Do not allow heavy pieces of metal to fall on the electrical cord.

D. Ironworker

1. Keep hands and fingers clear of the blade on the ironworker.

2. Do not run your hands over the cut edge of the just-cut metal. Painful cuts can be received from the burrs. Wear gloves when possible.

3. Tend to each cut immediately, no matter how minor.

4. Get help when cutting large pieces of metal. Stand clear and alert anyone else near the cutting area when making the cut.

5. Keep the work area clean and orderly. Pick up scrap pieces and place them in the scrap barrel or box. Reusable pieces should be placed back in storage and not left laying on the floor.

6. Keep feet clear when cutting. Painful injury can occur if large pieces fall on your feet.

7. Always wear goggles, safety glasses or an eye shield when cutting and while working in the shop.

E. Power Saws

1. Make sure work is securely clamped and supported when cutting.

2. Avoid binding or placing exessive force on the cutoff wheel. It could shatter and flying parts will cause severe injury.

3. Keep guards and shields in place at all times.

4. Always be sure that the machine is stopped and power off before making measurements or adjustments.

5. Always wear goggles, safety glasses or an eye shield when cutting and while working in the shop.

6. Get help when cutting heavy material.

7. Keep work area free of small pieces of metal and wipe up oil and grease spilled on the floor.

8. Handle pieces of metal just cut with care. Burrs on cut pieces are very sharp and can cause painful cuts. Wear gloves when possible.

9. Do not clean chips from the machine with your hands.

10. Do not attempt to remove chips or small pieces of material while the machine is running.

11. Follow the manufacturer's instruction for tightening the band saw blade. Too much tension could shatter the blade causing particles of flying steel.

12. Keep your hands clear of moving parts.

13. Have any cuts and scratches, even though minor, treated promtly.

WELDER'S HELPER

ANSWERS TO TEST

Part 1

I.	A.	True	K.	True
	B.	False	L.	False
	C.	True	M.	True
	D.	True	N.	True
	E.	True	O.	False
	F.	True	P.	True
	G.	False	Q.	True
	H.	True	R.	True
	I.	False	S.	True
	J.	True	T.	False

II.	A.	6	F.	8
	B.	7	G.	2
	C.	1	H.	9
	D.	10	I.	4
	E.	3	J.	5

III. A. Acetylene burning in air
- B. Nertral
- C. Carburizing
- D. Oxidizing

IV.	A.	T	V. 5
	B.	F	
	C.	T	
	D.	F	

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WELDER'S HELPER

ANSWERS TO TEST

Part 2

1. __3__ A.
__11__ B.
__9__ C.
__5__ D.
__7__ E.
__1__ F.
__10__ G.
__2__ H.
__4__ I.
__7__ J.
__8__ K.

2. __4__ A.
__1__ B.
__5__ C.
__3__ D.
__6__ E.
__2__ F.

3. __no__ A.
__yes__ B.
__no__ C.
__yes__ D.
__yes__ E.
__yes__ F.

4. ____ A.
__✓__ B.
__✓__ C.
__✓__ D.
____ E.
__✓__ F.
__✓__ G.
__✓__ H.

5. A. momentarily
B. pop
C. goes out
D. normally

6. A. inside the torch
B. to go out
C. beginning
D. smoking, hot
E. burn in half

7. 8 A.

7 B.

6 C.

1 D.

4 E.

3 F.

2 G.

5 H.

8. F A.

T B.

T C.

F D.

T E.

F F.

F G.

T H.

9. A. square

B. bevel

10. 2 A.

3 B.

1 C.

000 D.

4 E.

0 F.

00 G.

3/4" H.

WELDER'S HELPER

ANSWERS TO TEST

Part 3

1. 6 A.
10 B.
8 C.
7 D.
4 E.
12 F.
11 G.
3 H.
13 I.
1 J.
2 K.
9 L.
5 M.

2. Discussion should include:

   A. Welding with an electric arc was developed at the end of the 19th century.

   B. Electric arc welding was first used to join parts of a storage battery.

   C. Use of the arc welder failed in its early history because people were uninformed of its possibilities.

   D. Carbon arc welding was patented by a Russian inventor.

   E. Coatings were added to electrodes to keep out oxygen and nitrogen and to form a stronger weld.

3. AC welder A.
DC welder B.
AC-DC welder C.

4. A. Increase
B. Decrease
C. Reverse
D. Straight

5. yes A.
_____ B.
yes C.
yes D.
_____ E.
yes F.

6. 12 A.
2 B.
10 C.
3 D.
11 E.
6 F.
8 G.
5 H.
4 I.
9 J.
7 K.
1 L.

7. A. Helmet
   B. Clear plastic lens
   C. Rubber gasket
   D. Filter lens
   E. Clear plastic lens
   F. Hold-down clamp

8. False A.
   False B.
   False C.
   True D.
   False E.
   True F.
   True G.
   False H.
   True I.
   False J.
   True K.
   False L.
   True M.
   False N.
   True O.
   True P.
   True Q.
   True R.
   False S.
   False T.
   True U.
   True V.
   False W.
   True X.
   False Y.
   True Z.
   False Aa.

9. ✓ A.
   ✓ B.
   ____ C.
   ✓ D.
   ____ E.
   ✓ F.
   ✓ G.
   ____ H.
   ✓ I.

10. A. E stands for electrode
    B. 60 represents 60,000 pounds of tensile strength of deposited metal
    C. 1 stands for all position rod
    D. 3 represents the electrical characteristics of the rod

11. Diameter

12. A. Keeps air out of the molten puddle
    B. Allows the weld to cool more slowly, which makes the weld stronger
    C. Removes impurities from the weld puddle

D. Stablizes the arc

E. Prevents porousness of the weld metal

F. Adds alloys to weld metal for strength

G. Allows a faster deposit rate

13. A. Flat
B. Horizontal
C. Vertical
D. Overhead

14. A. Butt joint
B. Lab joint
C. Tee joint
D. Edge joint

15. A. Surface
B. Fillet
C. Groove
D. Plug and slot

16. 1 A.
8 B.
9 C.
2 D.
6 E.
3 F.
4 G.
5 H.
10 I.
11 J.
7 K.

WELDER'S HELPER

Answers to Test

Part 4

1. 1 A.
7 B.
6 C.
5 D.
4 E.
3 F.
2 G.

2. ✓ A.
____ B.
✓ C.
✓ D.
✓ E.
✓ F.

3. ✓ A.
✓ B.
✓ C.

4. ✓ A.
____ B.
✓ C.
✓ D.
✓ E.

5. ✓ A.
✓ B.
____ C.

6. ✓ A.
____ B.
____ C.
✓ D.
✓ E.

7. ✓ A.
____ B.
✓ C.
✓ D.
____ E.

WELDER'S HELPER

ANSWERS TO TEST

Part 5

1. a. 4
   b. 2
   c. 5
   d. 6
   e. 1
   f. 3
   g. 7

2. a.
   b.
   c. ✓
   d. ✓
   e. ✓
   f. ✓
   g. ✓
   h.
   i. ✓
   j. ✓
   k. ✓

3. a. Tungsten
   B. Inert
   C. Gas
   D. Shielding
   E. Arc

1. a. 2
   b. 1
   c. 3
   d. 1
   e. 1

2. a. 1
   b. 4
   c. 5
   d. 2
   e. 6
   f. 3

3. a. hour
   b. pounds
   c. upright
   d. carbon dioxide
   e. reduces

4. a. Argon
   b. Carbon dioxide
   c. 330 cubic feet
   d. Helium

5. a. 2
   b. 2
   c. 1
   d. 3
   e. 2

6. a. ceramic
   b. metal
   c. pyrex

WELDER'S HELPER

Answers to test

Part 6

1. a. Hand grinder
b. Pedestal grinder
c. Bench grinder
d. Drill press
e. Portable power shear
f. Squaring shear
g. Ironworker
h. Abrasive cutoff saw
i. Band saw
j. Power hacksaw

2. a. Water pot
b. Tool rest
c. Wheel guard
d. Switch
e. Motor
f. Shield
g. Wheel
h. Pedestal

3. a. Base
b. Table
c. Chuck
d. Spindle lock clamp
e. Depth guage
f. Switch
g. Speed adjustment handwheel
h. Power assembly
i. Feedwheel
j. Table clamp lever
k. Column

4. a. T
b. F
c. F
d. T
e. T
f. F
g. T
h. F
i. T
j. T

STUDY GUIDE OBJECTIVE

After completion of this study guide, the student will be able to perform the procedures and responsibilities required of a welder's helper. This knowledge will be evidenced through demonstration and by satisfactorily completing the test.

SPECIFIC OBJECTIVES

After completion of this study guide, the student will be able to:

1. Discuss briefly the history of oxyacetylene welding, and explain the safety rules to be followed when using oxyacetylene in welding.
2. Identify oxyacetylene welding equipment.
3. Recognize the proper flames for oxyacetylene welding.
4. Select the proper welding tips for oxyacetylene welding.
5. Select the correct terminology to be used when using the cutting torch.
6. Identify the different parts of the cutting torch.
7. Point out the hazard one might meet, and the reasons for poor torch cuts.
8. Select the proper cutting tips to be used when cutting.
9. Discuss briefly the history and terminology related to shielded metal arc welding.
10. List the types of arc welders and arc welding equipment.
11. Point out the safety rules that are related to metal arc welding.
12. List the basic types of electrodes, and point out other information related to electrodes.
13. Select the correct terminology to be used when working with shielded metal arc welding.
14. Explain the four weld types used in shielded metal arc welding.
15. Select the correct terminology to be used in MIG welding, and point out the advantages of MIG welding.
16. Select the correct terminology, the advantages, and the metals which can be welded by the TIG process.
17. Identify the equipment and how it is used in TIG welding.
18. Point out the different types of shop equipment, and explain how each is used.
19. Identify the correct safety practices to be followed while working with shop tools as a welder's helper.

WELDER'S HELPER

INFORMATION SHEET 1--HISTORY AND SAFETY

I. History

A. Acetylene--is a chemical combination of carbon and hydrogen (C_2H_2). Produced by mixing calcium carbide with water.

1. The discovery of an inexpensive method of manufacturing acetylene gas was by accident in 1892 by Thomas L. Willson, a Canadian inventor.
2. The use of acetylene with oxygen as a welding process became possible shortly before 1900.
3. The present day storage of acetylene in cylinders has proven to be safer than the acetylene generators.

B. Oxygen--an element found free as a colorless, tasteless gas forms about 21 percent of the atmosphere.

1. The main value of oxygen to the welding trade is that although it does not burn, it will speed up combustion.
2. Oxygen used in the oxyacetylene process is of such quality that it can be used not only to produce the oxyacetylene flame for welding and flame cutting, but also for medical needs.
3. When oxygen and acetylene are mixed in the correct proportions, the resulting flame is one of the hottest known with a temperature of 6300°F.

II. Safety

A. Cylinders should be secured in an upright position to a wall or dolly so they cannot be knocked over.

B. Acetylene cylinders should never be placed and used on their side since the acetylene is dissolved in acetone which will be drawn out with the acetylene when the cylinder is lying down.

C. Stop welding when the torch is burning with a purple flame. This indicates that the acetone is being drawn out.

D. Do not handle welding equipment with oily gloves, and do not oil regulators.

E. Remove dust and dirt from the valve openings by slightly opening and quickly closing cylinder valves before attaching a regulator.

F. Release the adjusting screw on the regulator before opening the cylinder valve so that no damage will occur to the regulator or injury to the operator.

G. Stand to one side of the regulator when opening the cylinder valve.

H. Open valves very slowly on cylinders.

I. Never use free-flowing acetylene at pressures above 15 PSI since it is very unstable.

J. Check every few days for leaks in hoses and fittings, using soapy water.

K. Purge lines separately before lighting the torch so that gas mixtures in lines will not cause flashback.

L. Have safety clothing and protection in place before lighting the torch.

M. Always light the acetylene before opening the oxygen on the torch.

N. Make sure that no person or any flammable material is in the direction of the flame when lighting and using the torch.

O. Do not use the oxygen in the torch to cool yourself because the oxygen will support combustion of materials that are usually not combustible.

(NOTE: This could cause your clothes to burn rapidly if you caught on fire.)

P. Know how to use fire extinguishers in the shop.

O. Open the acetylene cylinder valve no more than one and one-half turn so that it may be shut off quickly in case of a fire.

R. Avoid welding materials that give off combustion or toxic fumes.

S. Provide adequate ventilation in welding areas.

T. Close main cylinder valves when the oxyacetylene unit is not to be in use for long periods of time.

U. Follow manufacturers instructions when working with or shutting down the welding or cutting equipment.

V. Remove extra or empty cylinders from the welding area and building when possible. (Tag cylinders as empty)

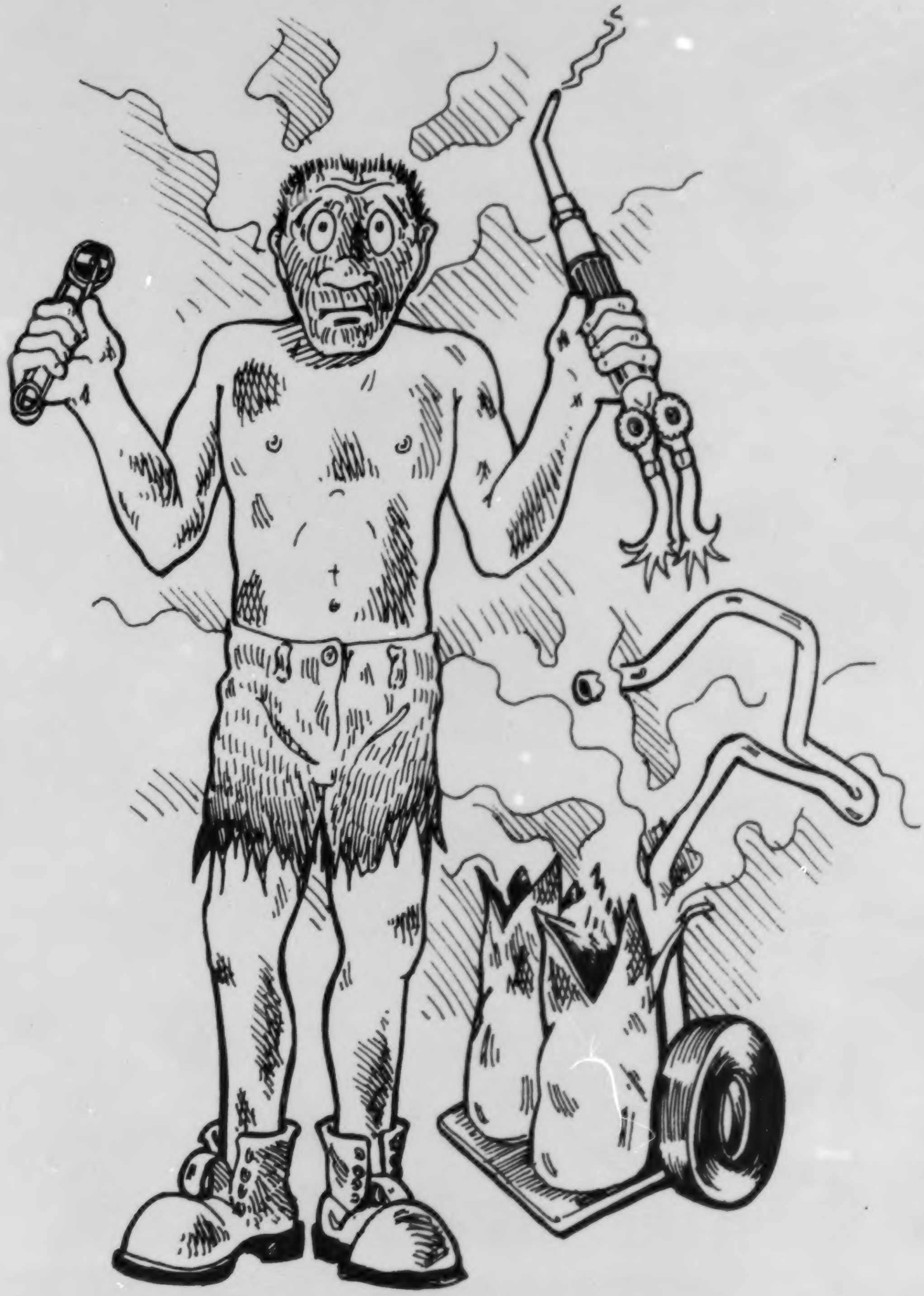
W. Place steel caps on all cylinders when trasnporting or storing them.

X. Keep welding area neat and free from extra materials.

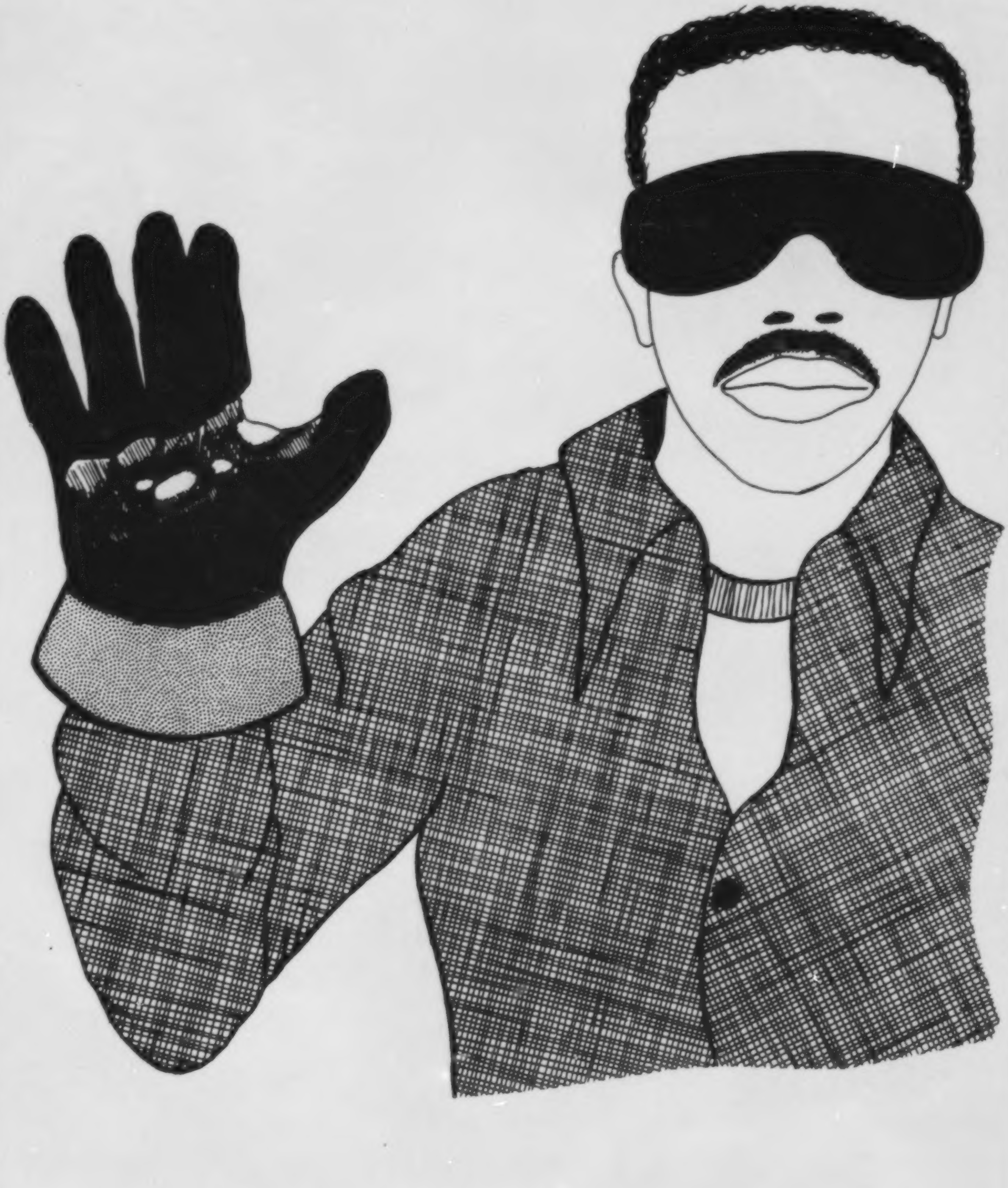
Y. Avoid handling hot metal with gloves. Use pliers.

Z. Use snug-fitting wrenches when installing or removing regulators.

LOOK BEFORE YOU LIGHT



DON'T PICK UP HOT METAL WITH GLOVES - USE PLIERS



ASSIGNMENT SHEET 1--OXYACETYLENE HISTORY AND SAFETY PRACTICES

A. Explain how acetylene is produced.

B. What is the principle value of oxygen to the welding trade?

C. List five safety practices one should observe when handling oxyacetylene equipment.

1.

2.

3.

4.

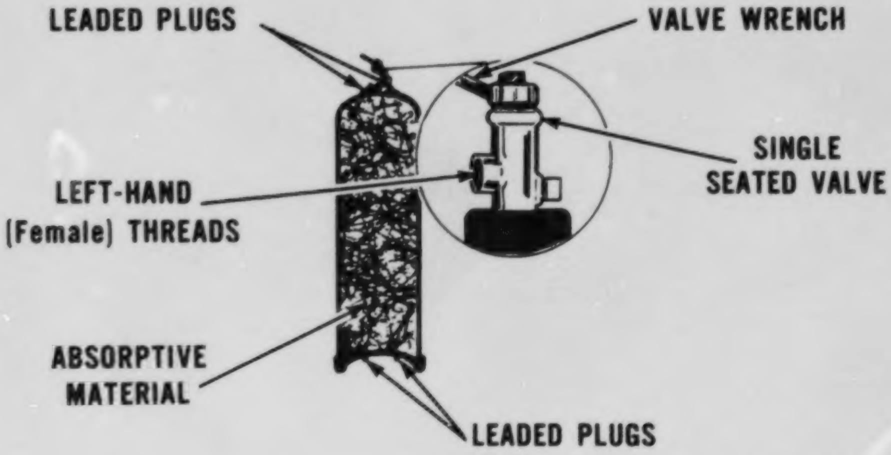
5.

INFORMATION SHEET 2--EQUIPMENT

I. Oxyacetylene Welding Equipment

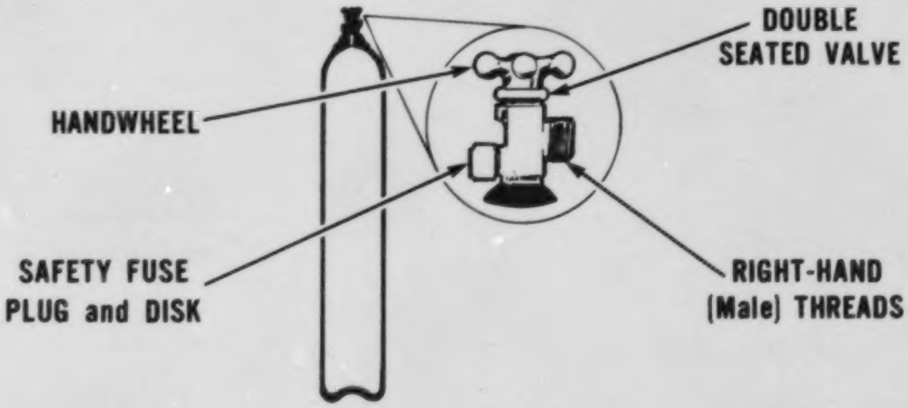
A. Cylinders

1. Aceylene--is a welded steel tank filled with a porous material which is saturated with a chemical solvent called acetone.


LEADED PLUGS
VALVE WRENCH
SINGLE SEATED VALVE
LEFT-HAND (Female) THREADS
ABSORPTIVE MATERIAL
LEADED PLUGS

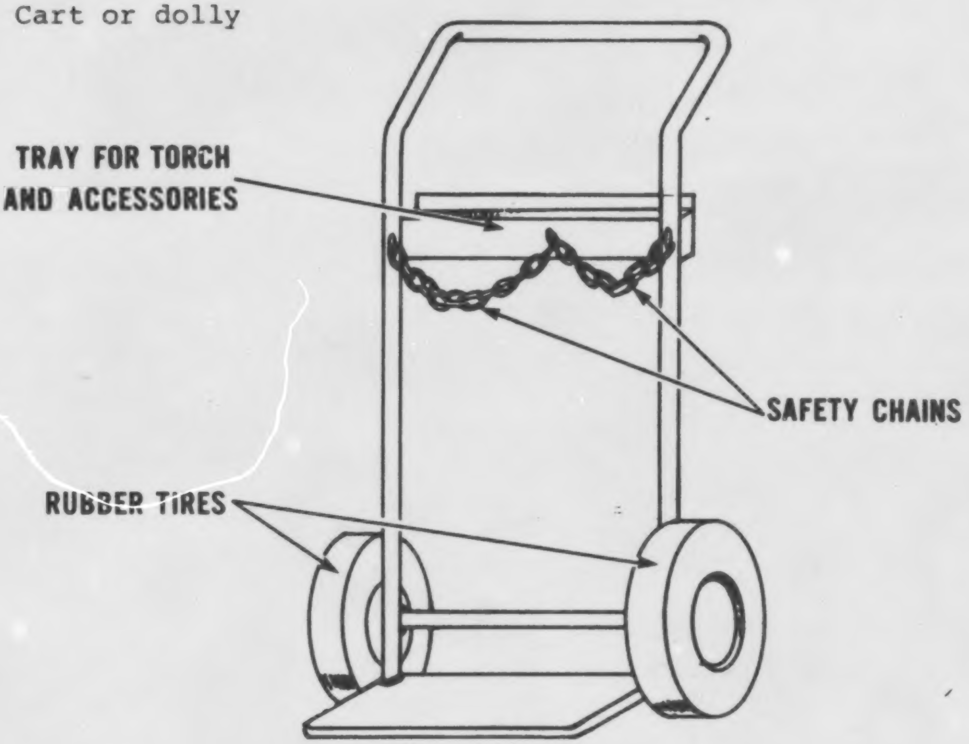
(NOTE: Typical cylinder sizes--60, 100, and 300 cu. ft.)

2. Oxygen--is a hollow tank made from seamless, drawn steel and tested with a water pressure of 3660 PSI. Oxygen cylinders are charged at a pressure of 2200 PSI at 70°F.

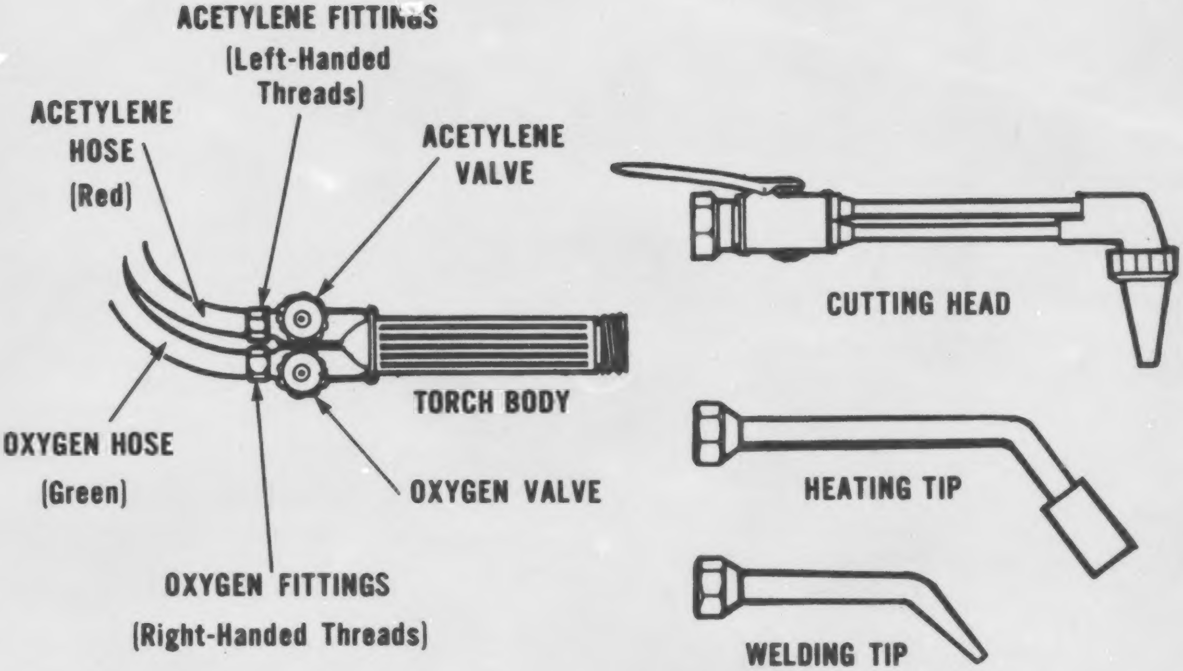

DOUBLE SEATED VALVE
HANDWHEEL
SAFETY FUSE PLUG and DISK
RIGHT-HAND (Male) THREADS

(NOTE: Typical cylinder sizes--80, 122 and 244 cu. ft.)

B. Cart or dolly

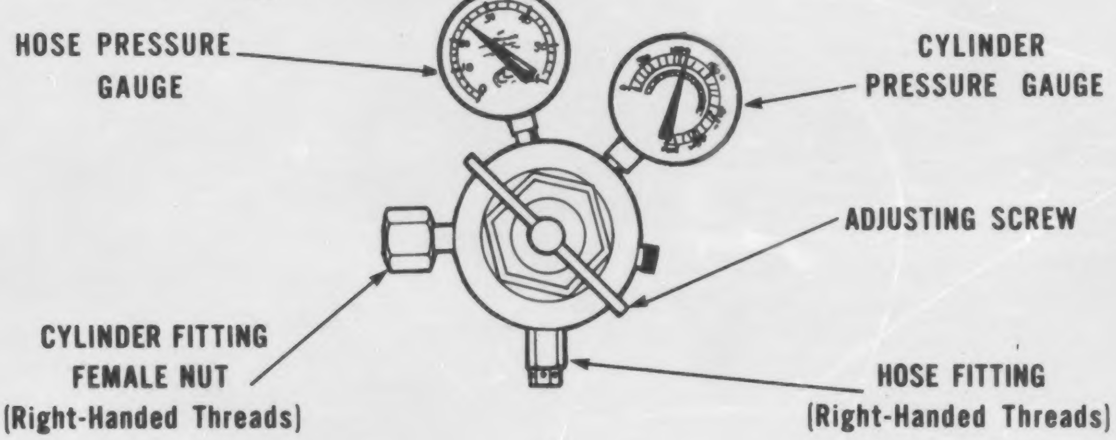

TRAY FOR TORCH AND ACCESSORIES
SAFETY CHAINS
RUBBER TIRES

C. Torch

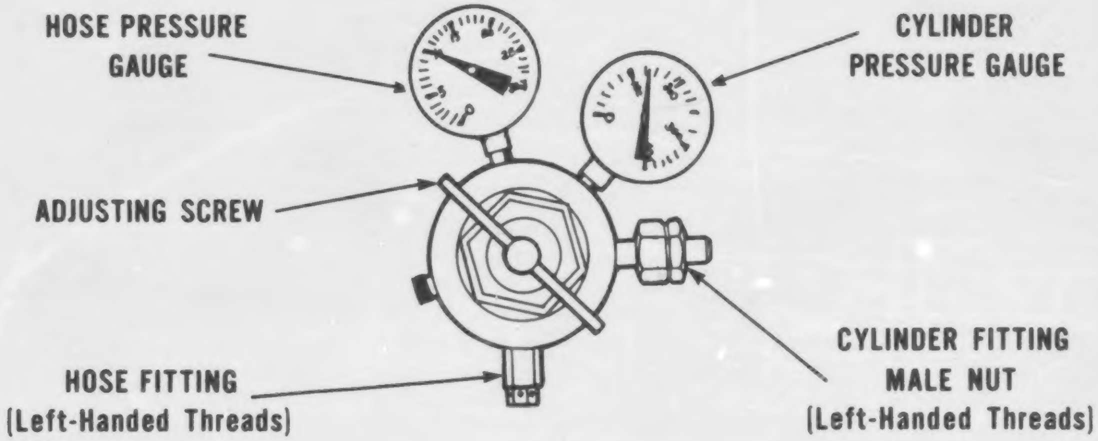

ACETYLENE FITTINGS (Left-Handed Threads)
ACETYLENE HOSE (Red)
ACETYLENE VALVE
CUTTING HEAD
TORCH BODY
OXYGEN HOSE (Green)
OXYGEN VALVE
HEATING TIP
OXYGEN FITTINGS (Right-Handed Threads)
WELDING TIP

D. Regulators

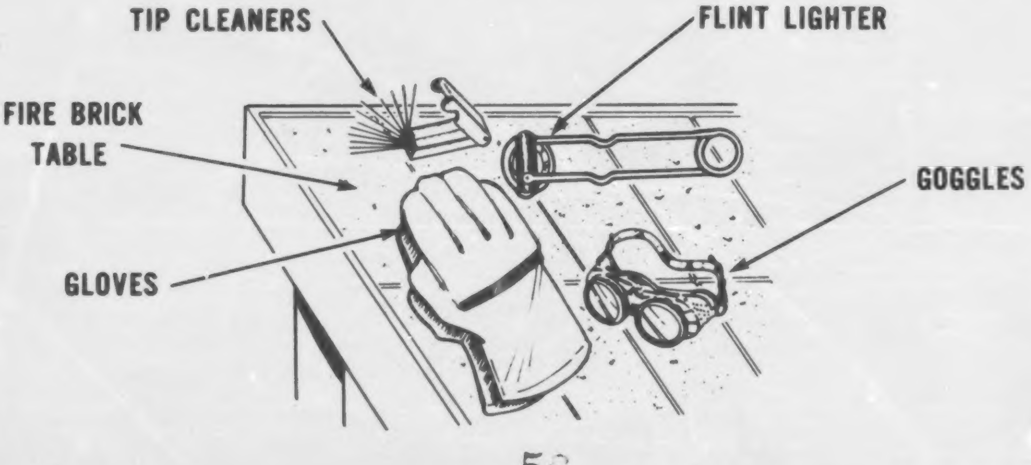
1. Oxygen


HOSE PRESSURE GAUGE
CYLINDER PRESSURE GAUGE
ADJUSTING SCREW
CYLINDER FITTING FEMALE NUT (Right-Handed Threads)
HOSE FITTING (Right-Handed Threads)

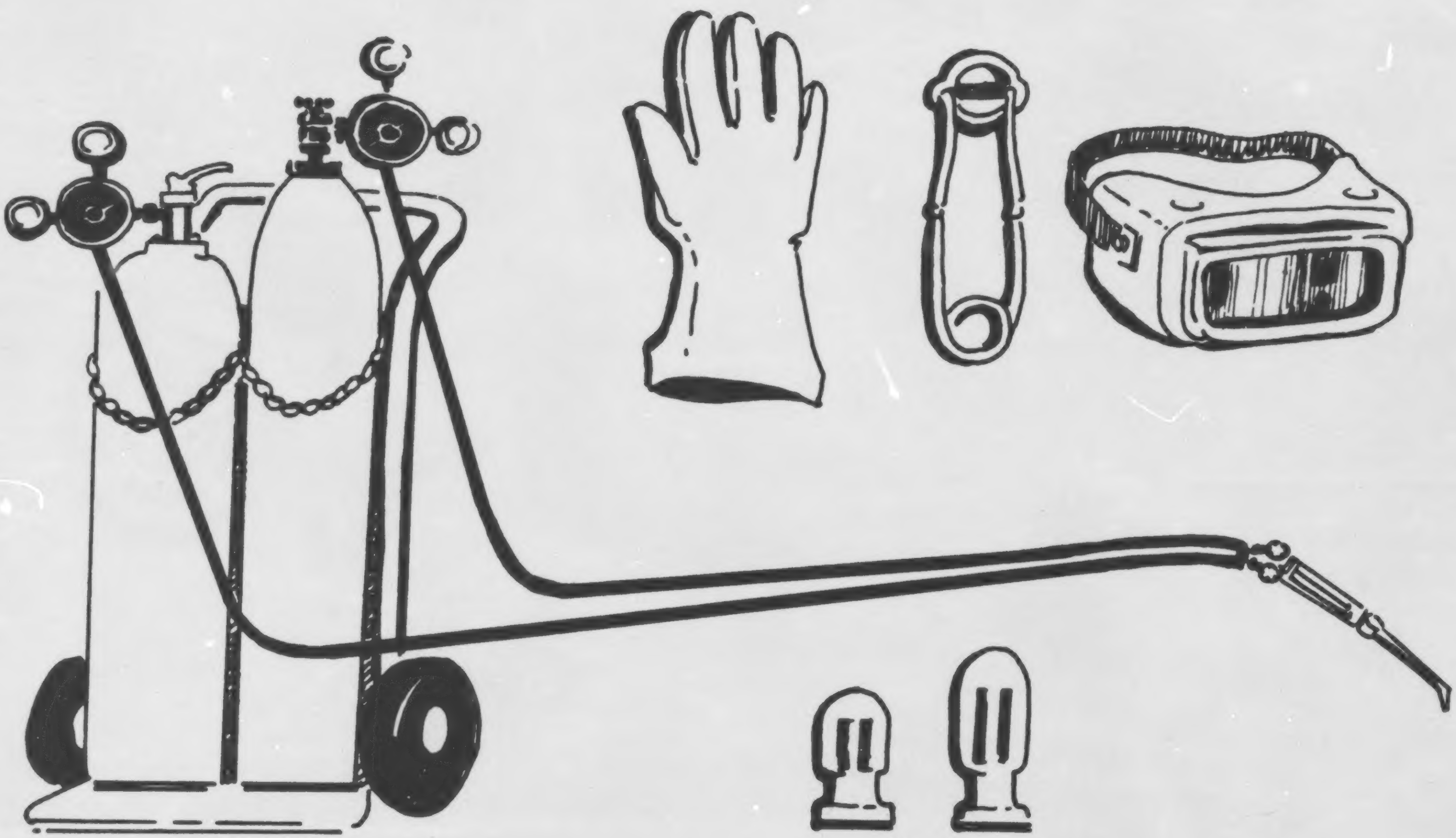
2. Acetylene


HOSE PRESSURE GAUGE
CYLINDER PRESSURE GAUGE
ADJUSTING SCREW
CYLINDER FITTING MALE NUT (Left-Handed Threads)
HOSE FITTING (Left-Handed Threads)

E. Accessories


TIP CLEANERS
FLINT LIGHTER
FIRE BRICK TABLE
GOGGLES
GLOVES

OXYACETYLENE WELDING EQUIPMENT

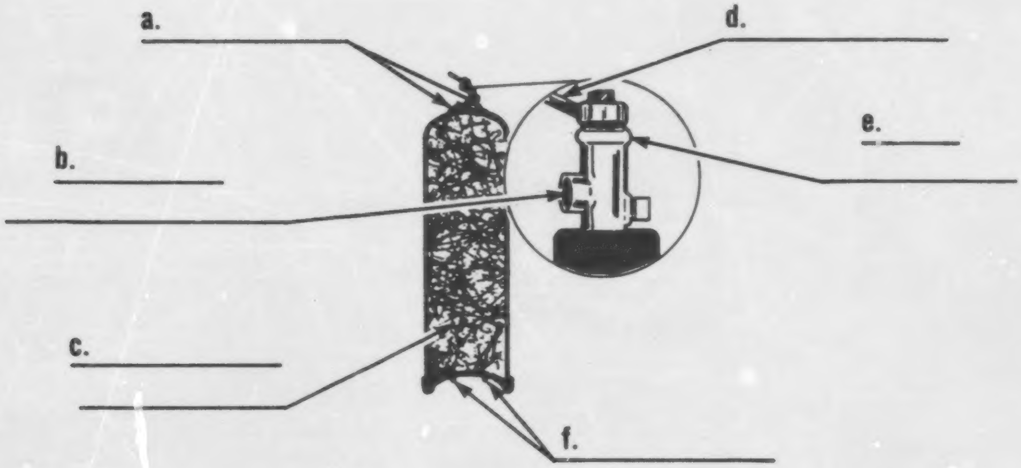


TM-3

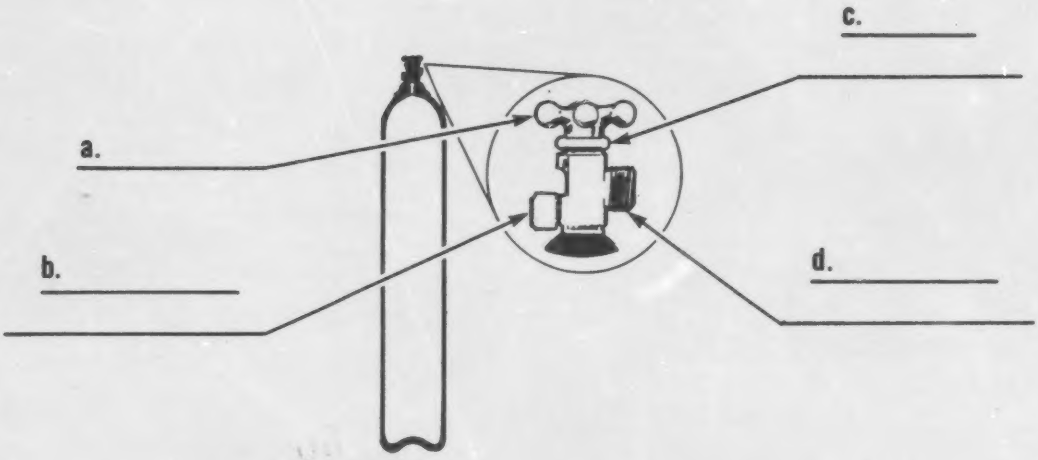
WELDER'S HELPER

ASSIGNMENT SHEET 2--OXYACETYLENE WELDING EQUIPMENT

A. Label the parts of the acetylene cylinder



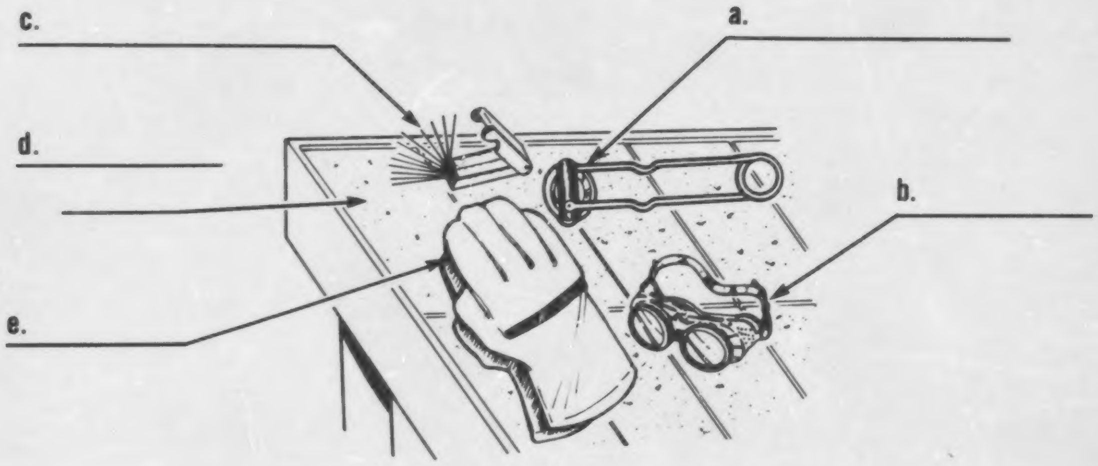
B. Label the parts of the oxygen cylinder



C. Draw a line from the cylinder to the statement that best describes the oxygen or acetylene cylinder

1. Oxygen cylinder	A. Seamless, high pressure tank with right-handed threads
2. Acetylene cylinder	B. Welded tank filled with porous material and has left-handed threads

D. Identify the following accessories:



INFORMATION SHEET 3--WELDING FLAMES

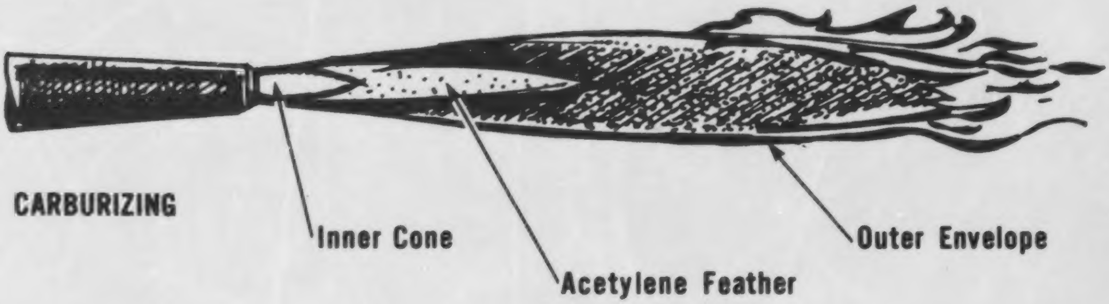
I. Types of oxyacetylene flames

   A. Carburizing

      1. Uses an excess amount of acetylene

      2. Can be identified by a third part in the flame known as an acetylene feather

      3. Used for hard-facing or surfacing and flame hardening


CARBURIZING
Inner Cone
Acetylene Feather
Outer Envelope

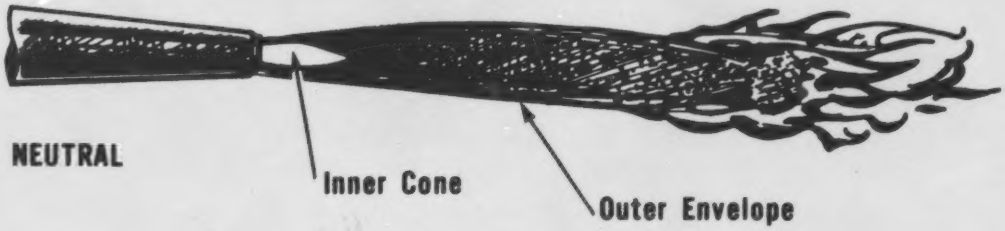
   B. Neutral

      1. Used for most fusion welding

      2. Uses equal amount of oxygen and acetylene

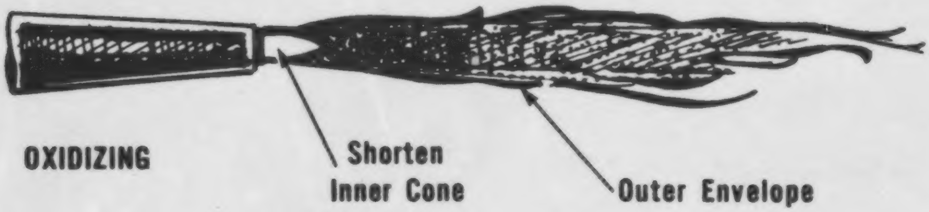
      3. Adds nothing to the metal and takes nothing away

      4. Produces a temperature of about 6000°F

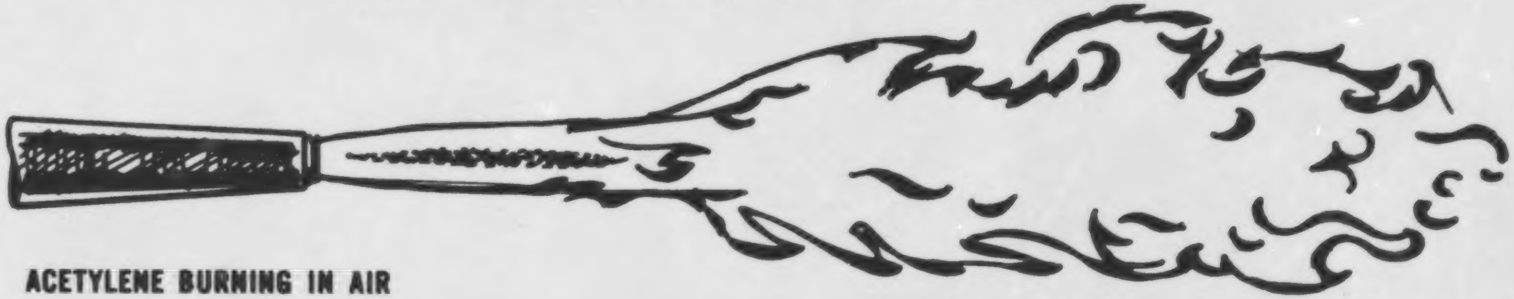

NEUTRAL
Inner Cone
Outer Envelope

C. Oxidizing

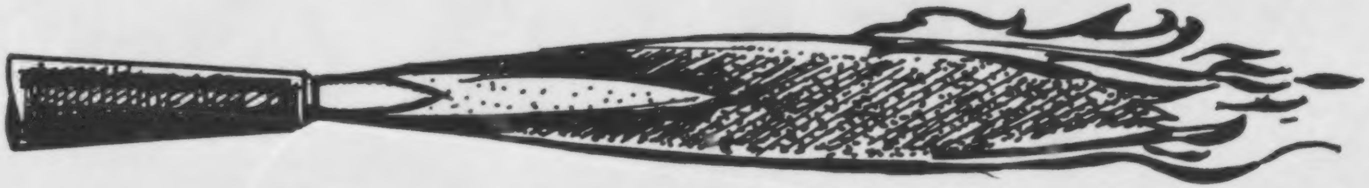
1. Uses an excessive amount of oxygen
2. Should avoid using this flame in fusion welding
3. Inner cone is shorter than in the neutral flame
4. Produces the hottest flame, 6300°F
5. Used for some braze welding with bronze rod


OXIDIZING
Shorten Inner Cone
Outer Envelope

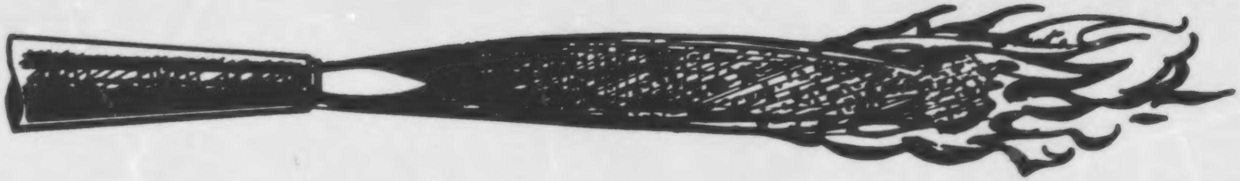
OXYACETYLENE WELDING FLAMES



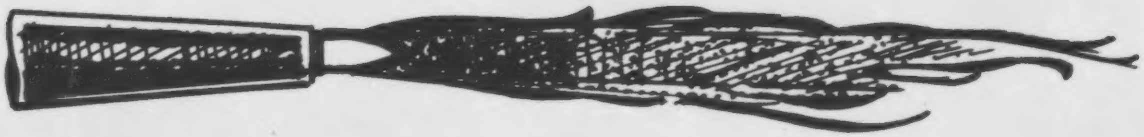
ACETYLENE BURNING IN AIR



CARBURIZING



NEUTRAL

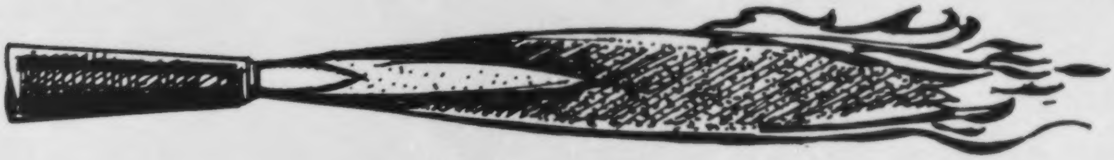


OXIDIZING

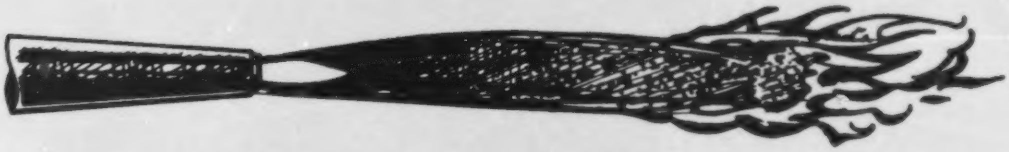
ASSIGNMENT SHEET 3--OXYACETYLENE FLAMES

Write the correct name of each of the oxyacetylene welding flames in the correct blank.

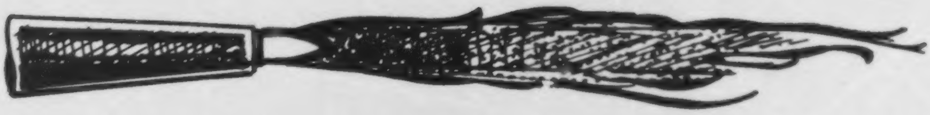
Neutral Carburizing Oxidizing



1. ____________________



2. ____________________



3. ____________________

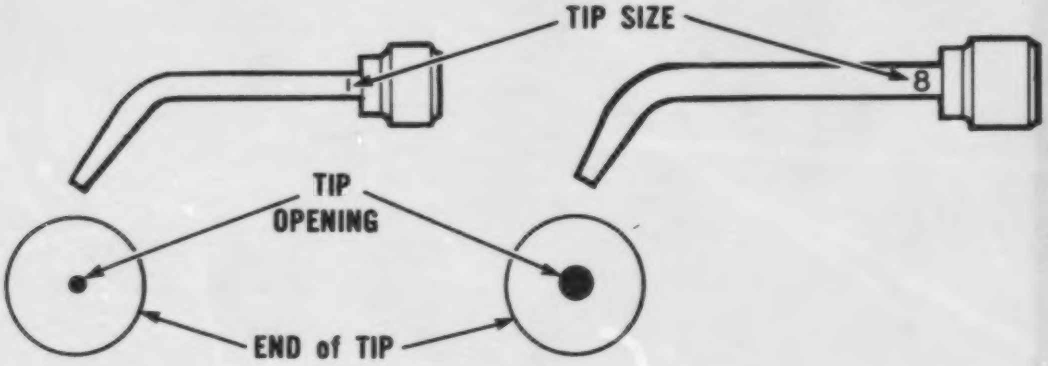
INFORMATION SHEET 4--SELECTING WELDING TIPS

I. Welding tips

A. The size of the tip is determined by the diameter (size of hole) of its opening which is marked on the tip.

B. The most common numbering system consists of numbers which range from 0 to 15.

C. The larger the number, the greater the tip diameter.



II. Selecting the correct tip

A. The size of the tip will depend upon the thickness of the metal to be welded.

B. As metal thickness increases, the diameter of the tip opening and the number of the tip becomes larger.

C. Too small a tip will not produce enough heat to melt the metal to the proper depth.

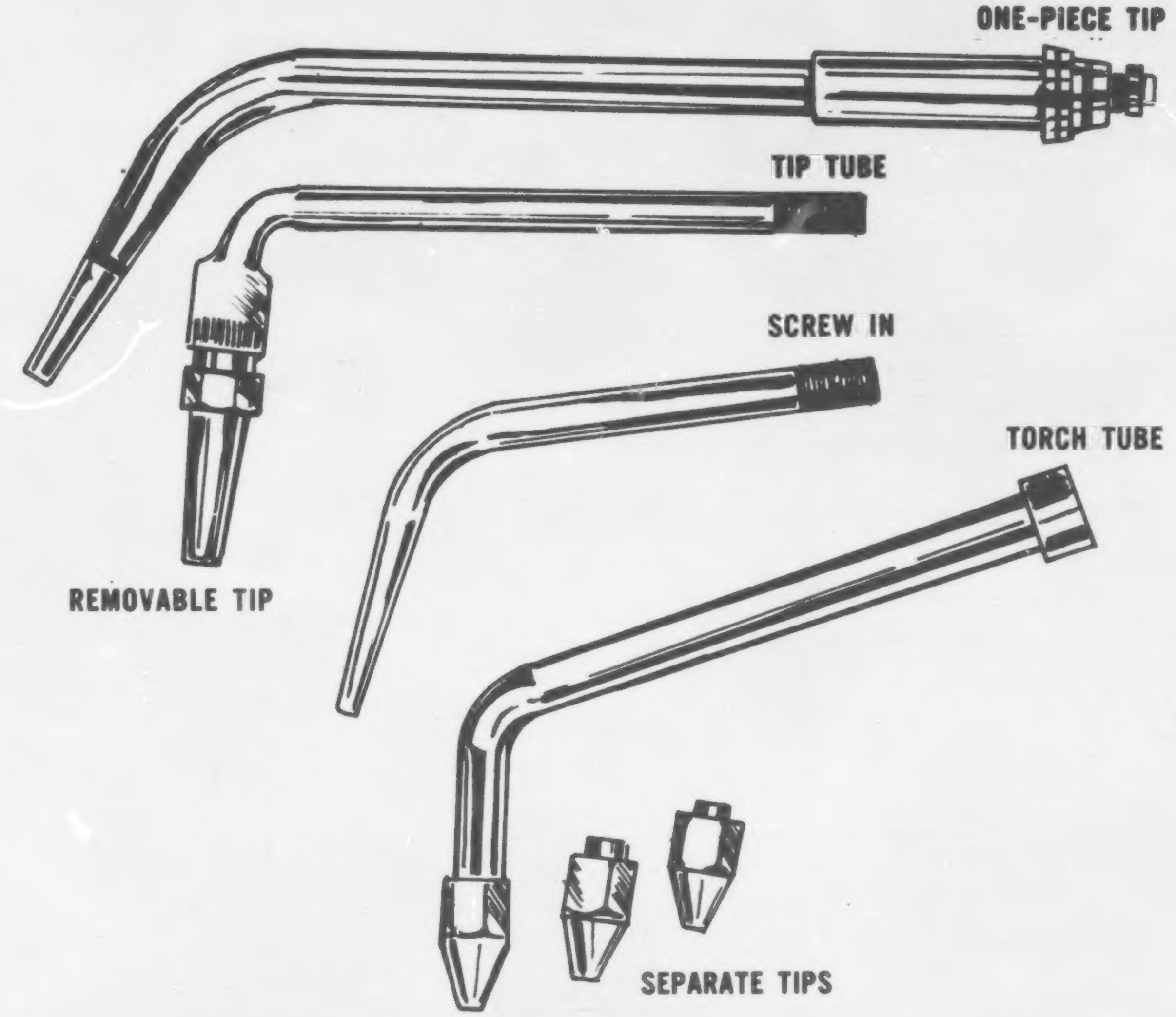
D. Too large a tip will produce too much heat and burn holes in the metal.

III. Tip sizes compared to metal thickness.

Tip Sizes Compared to Metal Thickness

TIP SIZE	METAL THICKNESS (inches)	OXYGEN PRESSURE (pounds)	ACETYLENE PRESSURE (pounds)
oo	1/64"	1	1
o	1/32"	1	1
1	1/16"	1	1
2	3/32"	2	2
3	1/8"	3	3
4	3/16"	4	4
5	1/4"	5	5
6	5/16"	6	6
7	3/8"	7	7
8	1/2"	8	8

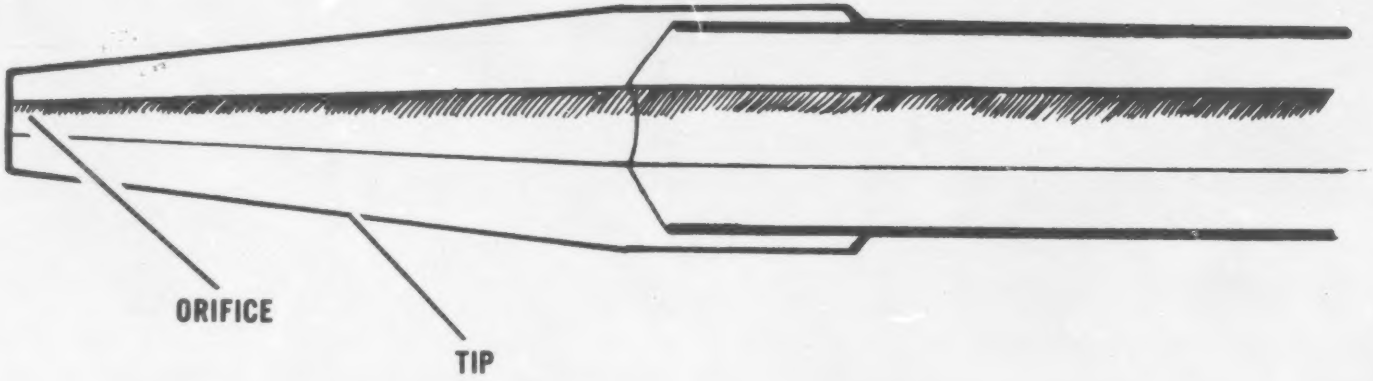
WELDING TIP DESIGNS

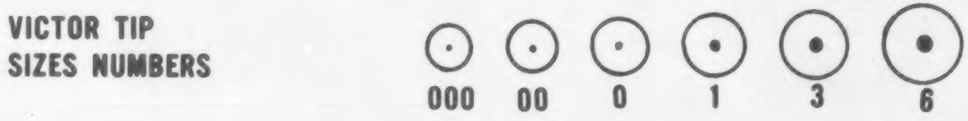

ONE-PIECE TIP
TIP TUBE
SCREW IN
TORCH TUBE
REMOVABLE TIP
SEPARATE TIPS

TM-5

27

WELDING TIP CUTAWAY VIEW AND ORIFICE SIZES


ORIFICE
TIP


VICTOR TIP
SIZES NUMBERS
000
00
0
1
3
6

COMPARISON OF ORIFICE SIZES

ASSIGNMENT SHEET 4--SELECTING WELDING TIPS

I. Using the chart from INFORMATION SHEET 4, record the tip size in the blank provided next to the thickness of metal to be welded.

____ A. 1/2"

____ B. 3/8"

____ C. 1/4"

____ D. 5/16"

____ E. 1/32"

____ F. 1/64"

____ G. 1/8"

____ H. 1/16"

II. From the chart, record the correct pressure in the blank provided next to the tip size.

____ A. 00

____ B. 7

____ C. 4

____ D. 8

____ E. 2

____ F. 1

____ G. 3

____ H. 0

WELDER'S HELPER

TEST--PART 1

I. Point out the correct historical facts and safety rules by writing True or False for each of the following statements.

_____ A. The principal value of oxygen to the welding trade is that it will greatly accelerate (speed up) combustion.

_____ B. Oxygen is produced by mixing calcium carbide with water.

_____ C. Cylinders should be secured to a wall or dolly in an upright position so they cannot be knocked over.

_____ D. Acetylene cylinders should never be placed on their sides as the acetylene gas is in a liquid state and the acetone will be drawn out.

_____ E. Do not handle welding equipment with oily gloves or oil the regulators.

_____ F. Release the adjusting screw on regulator before opening the cylinder valve so no damage will occur to the regulator or injury to the operator.

_____ G. Stand directly in front of the regulator when opening the cylinder valve so that you can see the regulator better.

_____ H. Never use free-flowing acetylene at pressures above 15 PSI because it is very unstable.

_____ I. Check for leaks in hoses and fittings every 15 minutes with soapy water.

_____ J. Have safety clothing and protection in place before lighting.

_____ K. Make sure that no one or any flammable material is in the direction of the flame when lighting and using the torch.

_____ L. Oxygen is a cooling gas and can be used to cool oneself on a hot day.

_____ M. Know how to use fire extinguishers in the shop.

_____ N. Avoid welding on materials that have combustible or toxic fumes given off.

_____ O. Ventilation in welding areas is not necessary because smoke rises.

_____ P. Close the main cylinder when the oxyacetylene unit is not in use for long periods of time.

_____ Q. Place steel caps on all cylinders when transporting or storing them.

_____ R. Keep welding area neat and free from extra materials.

_____ S. Avoid handling hot metal with gloves.

_____ T. Use loose-fitting wrenches when installing or removing regulators so the wrenches may be removed quickly.

II. Write the number of each part of the oxyacetylene welding equipment by its correct name.

_____ A. Oxygen cylinder

_____ B. Acetylene cylinder

_____ C. Cylinder valves

_____ D. Adjusting nut

_____ E. Cart

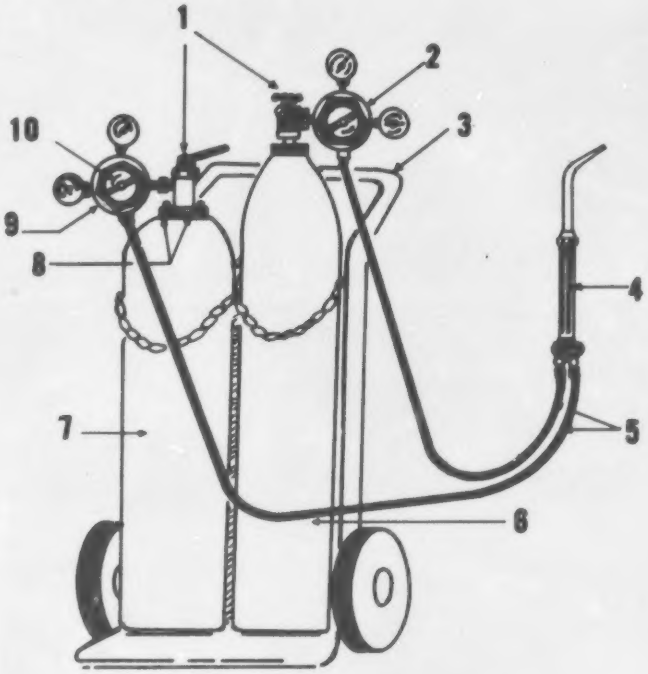
_____ F. Leaded plugs

_____ G. Oxygen regulator

_____ H. Acetylene regulator

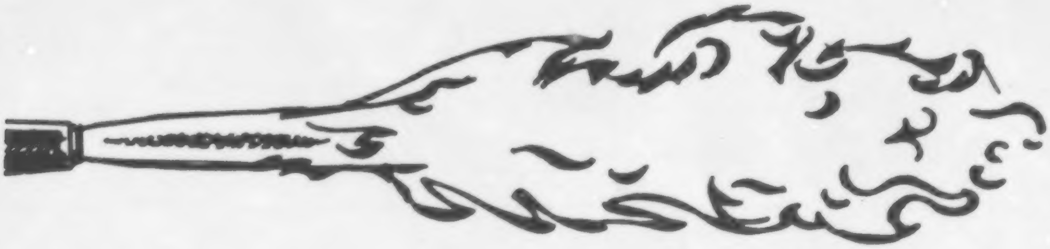
_____ I. Torch body

_____ J. Hoses

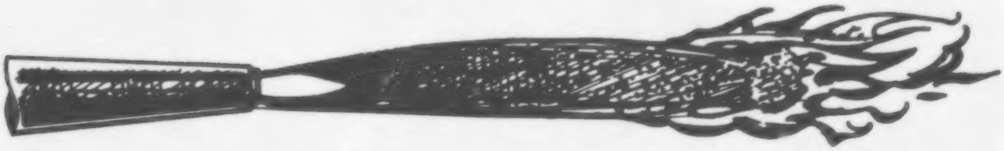


III. Write the correct neme of each of the oxyacetylene welding flames in the correct blank.

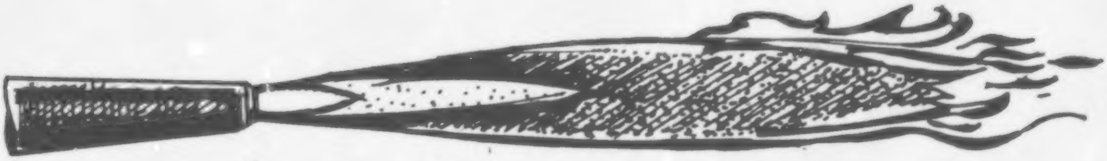
Neutral	Acetylene burning in air
Oxidizing	Carburizing



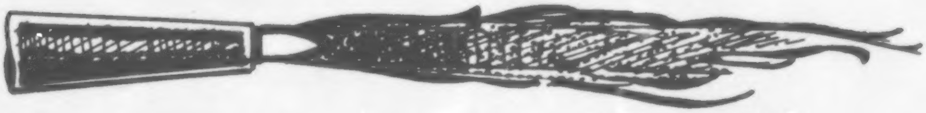
A. ____________________



B. ____________________



C. ____________________



D. ____________________

IV. True or False: If the following statements are true, place a "T" in the blank and a "F" in the blank if the statement is false.

___ A. The size of the tip is determined by the diameter (size of hole) of its opening which is marked on the tip.

___ B. As the number of the tip becomes larger, the diameter (size of hole) of the tip becomes smaller.

___ C. As metal thickness increases, the diameter of the tip opening and the number of the tip becomes larger.

___ D. Too small a tip will produce too much heat and burns holes in the metal.

V. From the chart, select the correct tip size for welding 1/4" metal.

Tip Sizes Compared to Metal Thickness

TIP SIZE	METAL THICKNESS (inches)	OXYGEN PRESSURE (pounds)	ACETYLENE PRESSURE (pounds)
oo	1/64"	1	1
o	1/32"	1	1
1	1/16"	1	1
2	3/32"	2	2
3	1/8"	3	3
4	3/16"	4	4
5	1/4"	5	5
6	5/16"	6	6
7	3/8"	7	7
8	1/2"	8	8

WELDER'S HELPER

INFORMATION SHEET 5--CUTTING TORCH TERMINOLOGY

I. Terms and definitions

A. Flame cutting--the process by which steel is removed by heating it to the melting point and then rapidly oxidizing it with pure oxygen under pressure

B. Oxidizing--combining oxygen with steel, forming a scale or slag

C. Slag--the deposits or oxides left after a cut has been made

D. Oxides--rust, corrosion, scale coating, or slag

E. Kerf--area where metal was removed in the form of oxides during the cutting process

F. Drag line--the lines formed on the metal being cut which appear to be lagging behind at the bottom of the cut

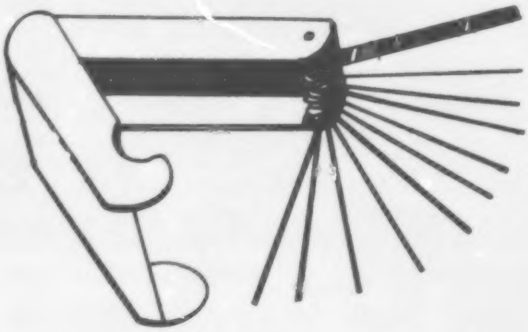
G. Flashback--fire burning inside the torch

H. Backfire--a sudden burning of the flame back into the torch as the flame goes out with a "pop"

I. Preheat time--heating the metal at the starting point of a cut to its melting temperature

J. Preheat orifice--a device used to combine the gases to produce a preheat flame

K. Tip cleaners--a device with different-sized wires to remove carbon deposits from welding tips



ASSIGNMENT SHEET 5--CUTTING TORCH TERMINOLOGY

I. Write the correct term defined in the blank beside the definition.

- Tip cleaner
- Preheat orifice
- Flame cutting
- Kerf
- Oxidizing
- Preheat time
- Flashback
- Drag line
- Oxides
- backfire
- slag

_______________ A. The process by which steel is removed by heating it to the melting point and then rapidly oxidizing it with pure oxygen under pressure

_______________ B. Combining oxygen with steel, forming a scale or slag

_______________ C. The deposits or oxides left after a cut has been made

_______________ D. Rust, corrosion, scale coating, or slag

_______________ E. Area where metal was removed in the form of oxides during the cutting process

_______________ F. The lines formed on the metal being cut which appear to be lagging behind at the bottom of the cut

_______________ G. Fire burning inside the torch

_______________ H. A sudden burning of the flame back into the torch as the flame goes out with a "pop"

_______________ I. Heating the metal at the starting point of a cut to its melting temperature

_______________ J. A device used to combine the gases to produce a preheat flame

_______________ K. A device with different-sized wires to remove carbon deposits from welding tips

INFORMATION SHEET 6--THE CUTTING TORCH

I. Parts of a Cutting Torch

A. Cutting tip

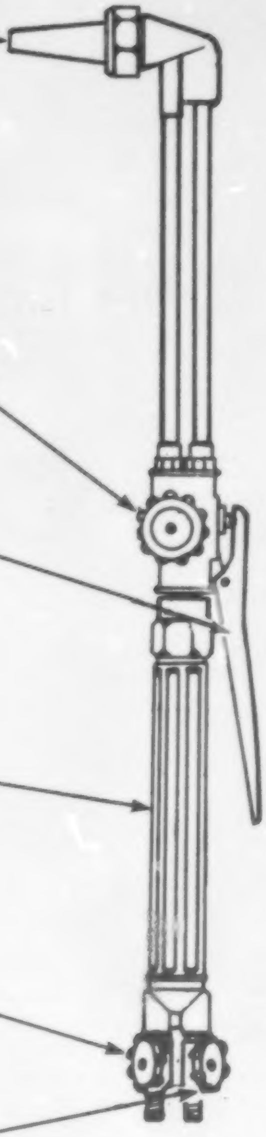
B. Oxygen pre-heat valve

C. Cutting oxygen lever

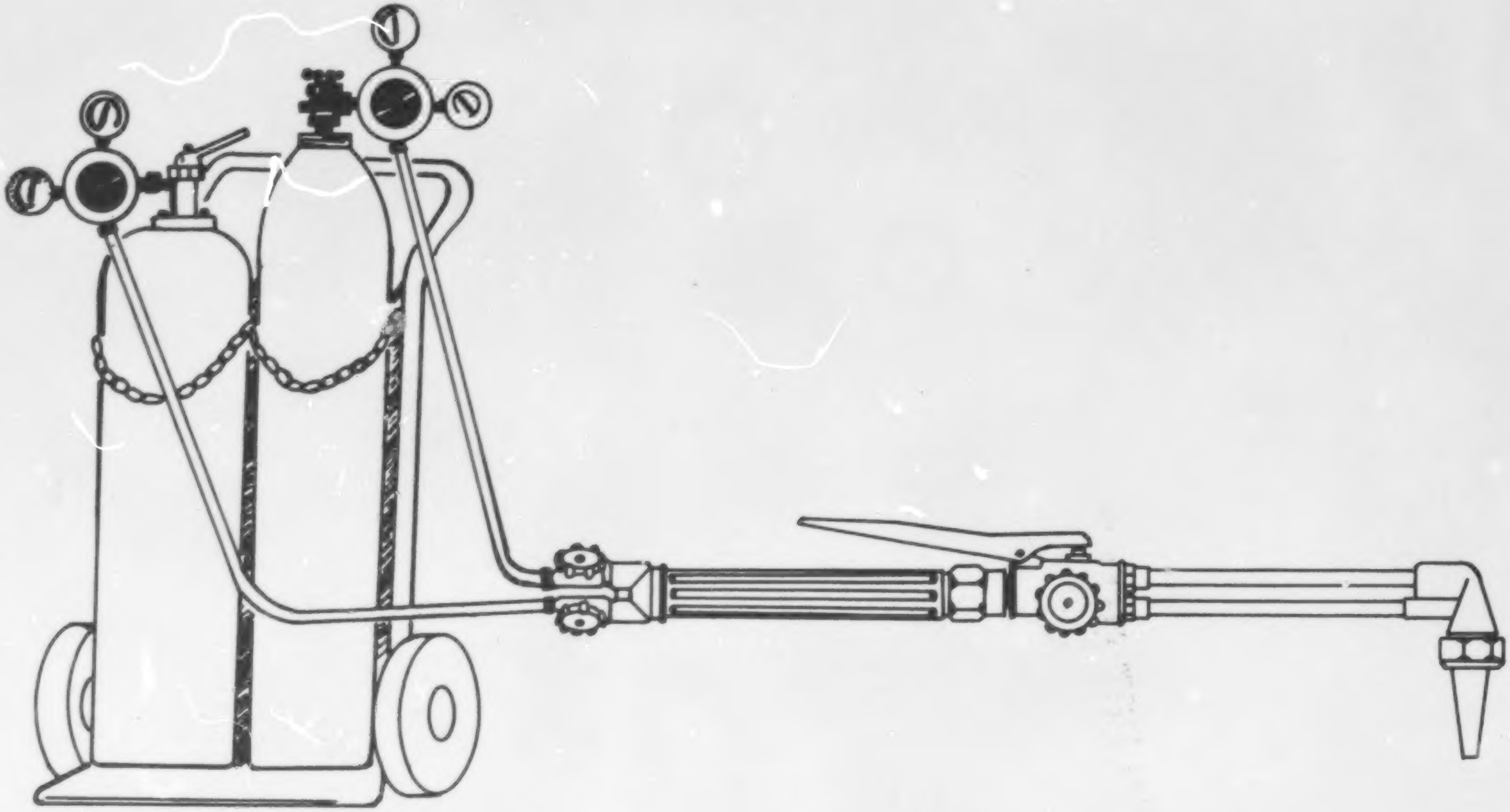
D. Torch body

E. Acetylene torch valve

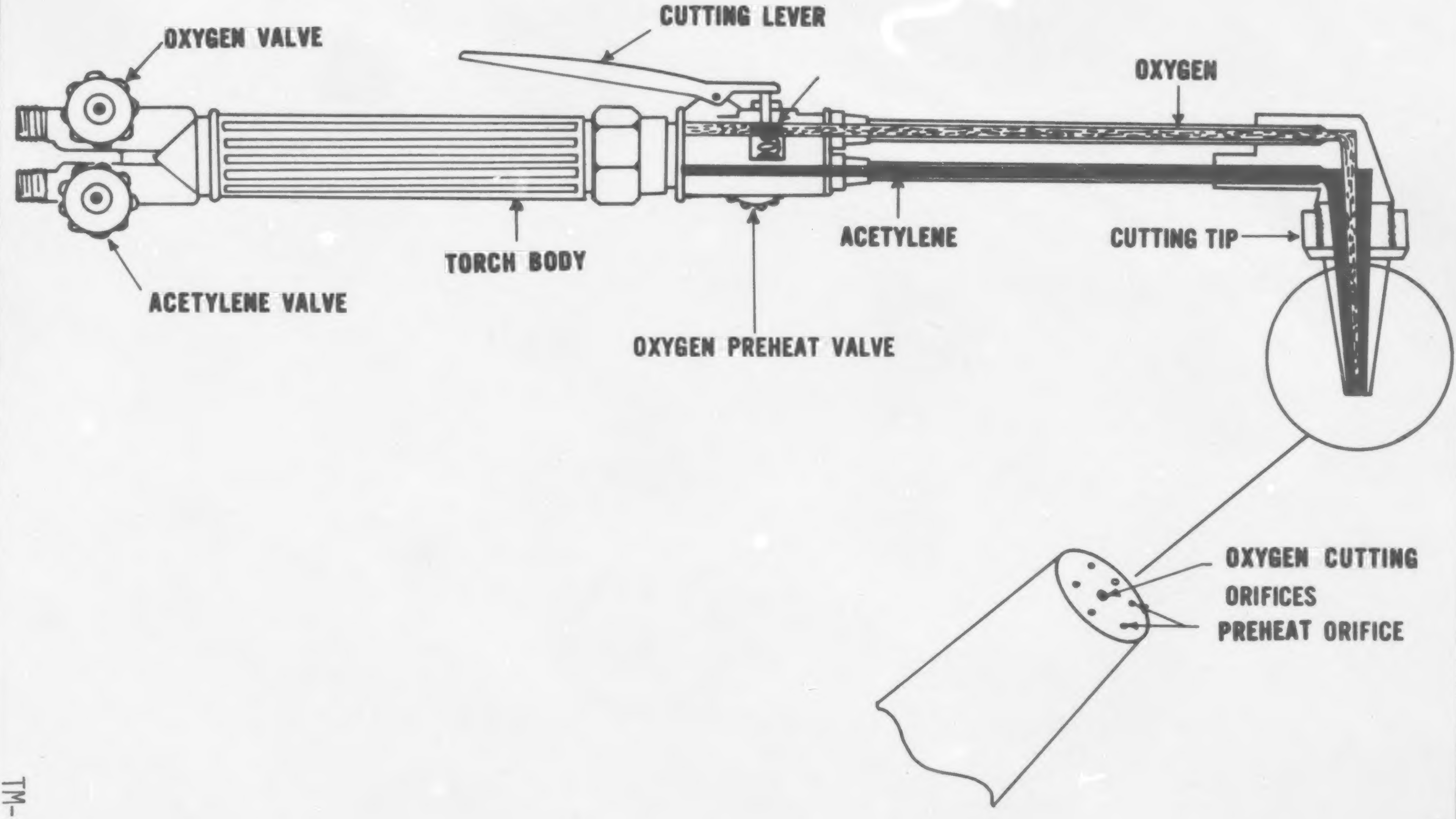
F. Oxygen torch valve



CUTTING TORCH EQUIPMENT



CUTTING TORCHES


OXYGEN VALVE
CUTTING LEVER
OXYGEN
TORCH BODY
ACETYLENE
CUTTING TIP
ACETYLENE VALVE
OXYGEN PREHEAT VALVE
OXYGEN CUTTING ORIFICES
PREHEAT ORIFICE

TM-8

WELDER'S HELPER

ASSIGNMENT SHEET 6--THE CUTTING TORCH

I. Place the correct name of the part for the cutting torch in the blank.

Oxygen torch valve

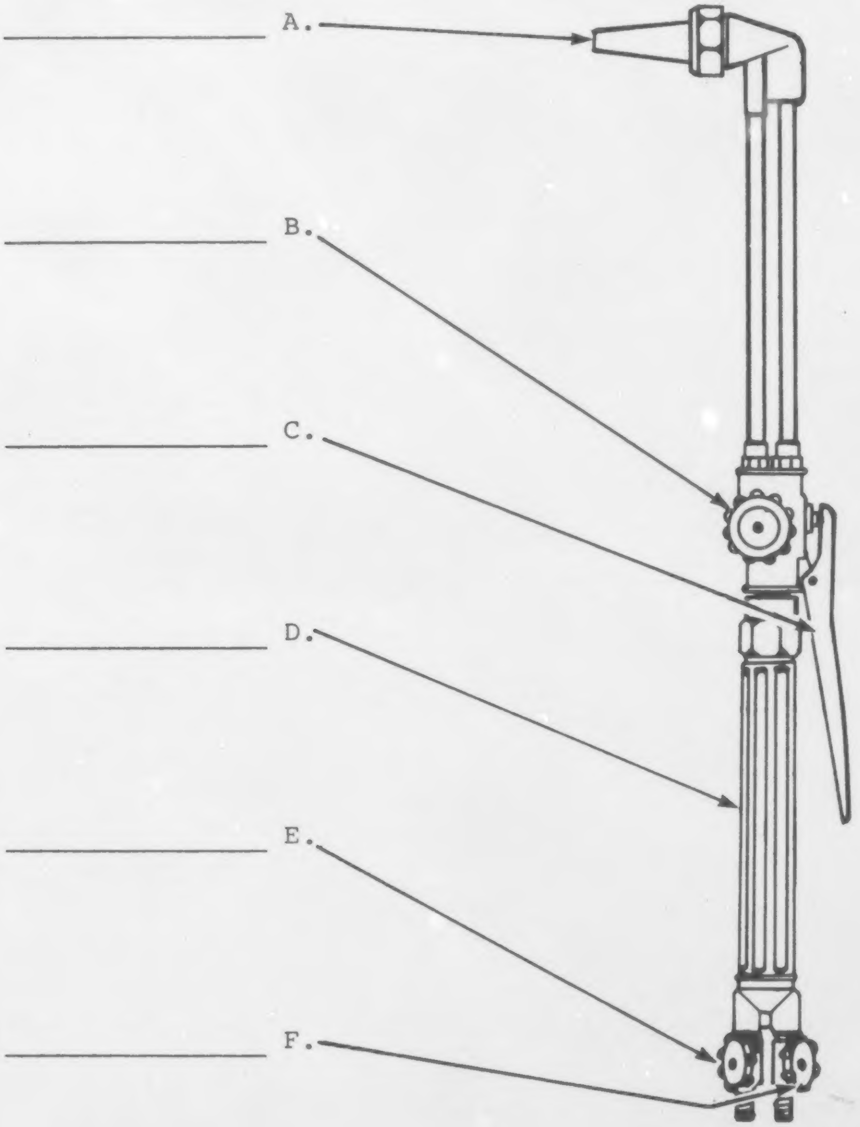
Torch body

Cutting oxygen lever

Cutting tip

Acetylene torch valve

Oxygen pre-heat valve



______________ A.

______________ B.

______________ C.

______________ D.

______________ E.

______________ F.

INFORMATION SHEET 7--THE CUTTING PROCESS

I. Hazards of Hot Slag

- A. Will cause burns to body
- B. Will burn hoses
- C. Causes fires in clothing
- D. Forms sharp edges on cut metal
- E. Will cause concrete to explode

II. Causes of a backfire

- A. Acetylene or oxygen pressure too low
- B. Cutting tip nut loose
- C. Slag or splatter on tip
- D. Overheating the cutting tip
    - 1. Cutting in a tight corner
    - 2. Piercing a hole in thick metal
    - 3. Cutting in a recessed area
- E. Faulty O-rings
- F. Rust or dirt on metal being welded

III. Results of a backfire

- A. Flame momentarily burns inside tip
- B. There is usually a loud pop
- C. The flame sometimes goes out
- D. The flame may continue to burn normally

IV. Results of a flashback

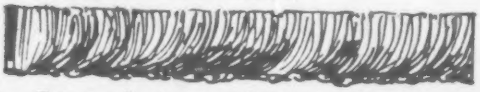
- A. A fire burning inside the torch
- B. The flame seems to go out
- C. A squealing or hissing noise begins
- D. Torch starts smoking and getting hot

E. Torch will burn in half in flashback continues

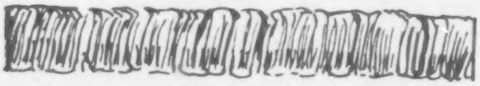
(NOTE: Immediately shut off torch by closing the oxygen valve and then the acetylene valve on the torch.)

V. Reasons for poor cuts

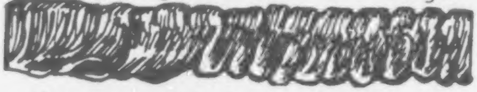
A. Travel too fast



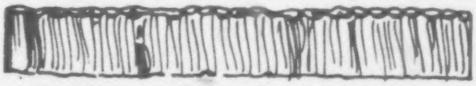
B. Travel too slow



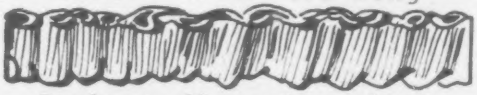
C. Oxygen pressure too high



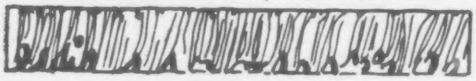
D. Oxygen pressure too low



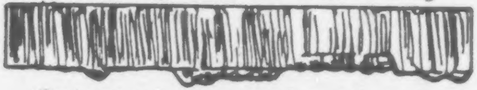
E. Preheat flame too long



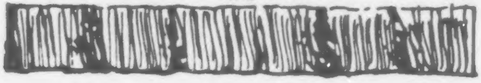
F. Preheat flame too short



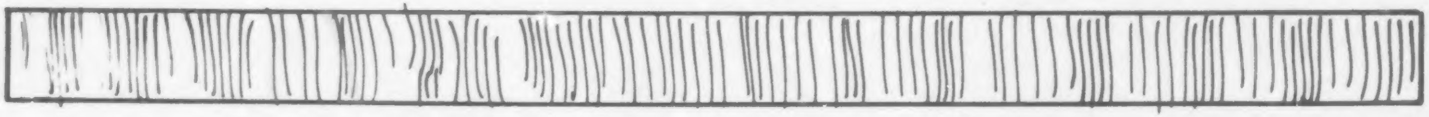
G. Unsteady torch handling

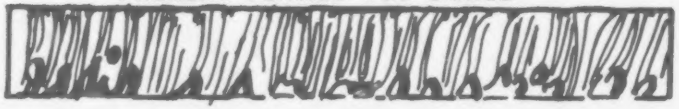


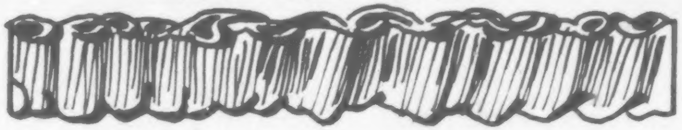
H. Cut was stopped and started poorly

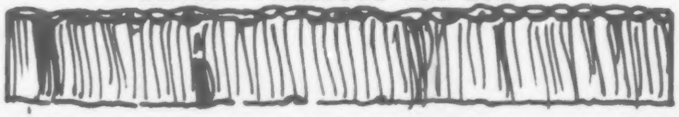


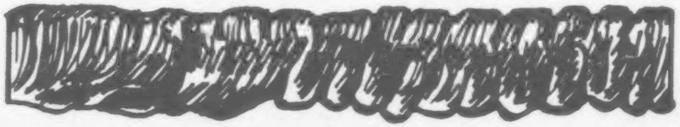
EXAMPLES OF POOR TORCH CUTS

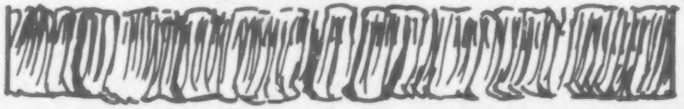

A GOOD CUT


PREHEAT FLAMES TOO SMALL

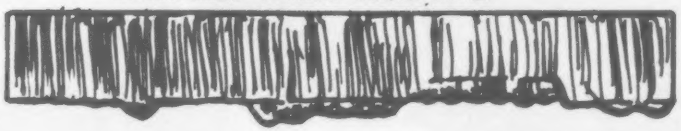

PREHEAT FLAMES TOO LONG

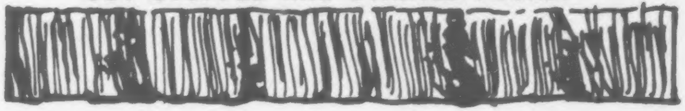

OXYGEN PRESSURE TOO LOW


OXYGEN PRESSURE TOO HIGH


CUTTING SPEED TOO SLOW

CUTTING SPEED TOO FAST


UNSTEADY TORCH HANDLING


CUT STOPPED AND STARTED POORLY

ASSIGNMENT SHEET 7--THE CUTTING PROCESS

I. List four hazards involving hot slag

A.

B.

C.

D.

II. List four causes of backfire

A.

B.

C.

D.

III. List the results of a backfire

A.

B.

C.

D.

IV. List the results of a flashback

A.

B.

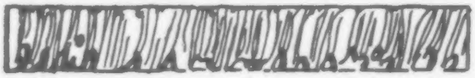
C.

D.

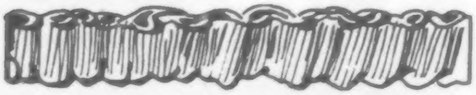
E.

V. Determine the reasons for poor torch cuts by placing the number of the reason next to the correct torch cut illustration.

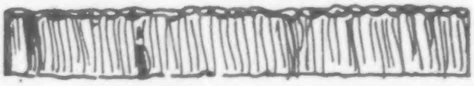
____ A.



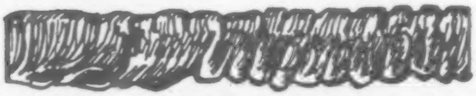
____ B.



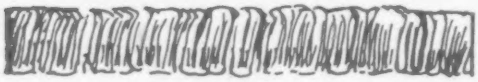
____ C.



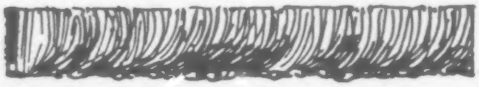
____ D.



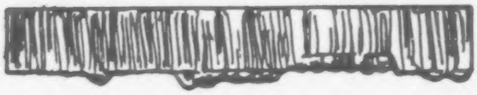
____ E.



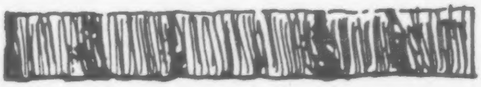
____ F.



____ G.



____ H.



1. Oxygen pressure too high
2. Unsteady torch movement
3. Cutting speed fast
4. Cutting speed slow
5. Cut stopped and started poorly
6. Oxygen pressure too low
7. Preheat flames too long
8. Preheat flames too small

INFORMATION SHEET 8--SELECTING CUTTING TIPS

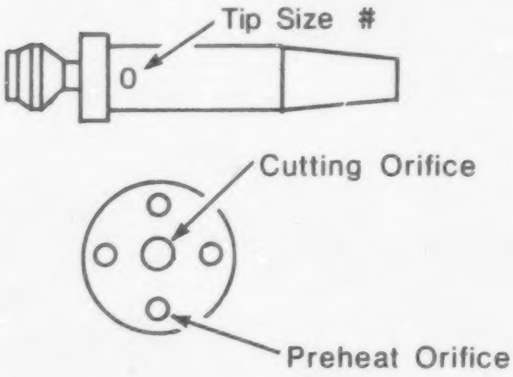
I. Cutting tips

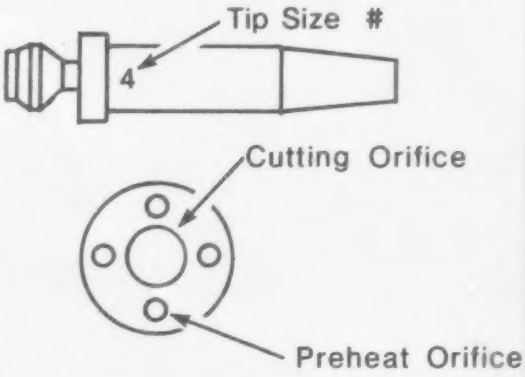
A. The size of the cutting tip is determined by the diameter of the cutting orifice (center hole) which is marked on the tip.

B. The most common numbering system consists of numbers which range from 000 to 8.

C. The larger the cutting tip number, the greater the diameter of the cutting orifice (center hole).

D. The cutting orifice (center hole) is circled by the preheat orifices. Typically four or six in number. See figure 1





II. Selecting the correct tip

A. The size of the cutting tip will depend upon the thickness of the metal to be cut.

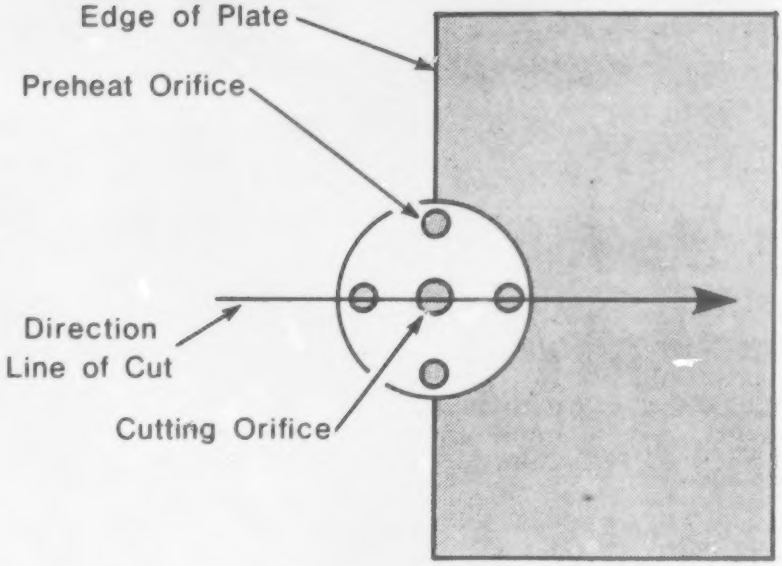
B. As metal thickness increases, the diameter of the cutting orifice (center hole) and the number on the tip becomes larger.

C. Not enough heat will be produced if the tip size is too small. This will make it very difficult and time consuming to cut with this tip.

D. Too much heat will be produced if the tip size is too large. This will produce excessive melt and slag while consuming excessive oxygen and acetylene.

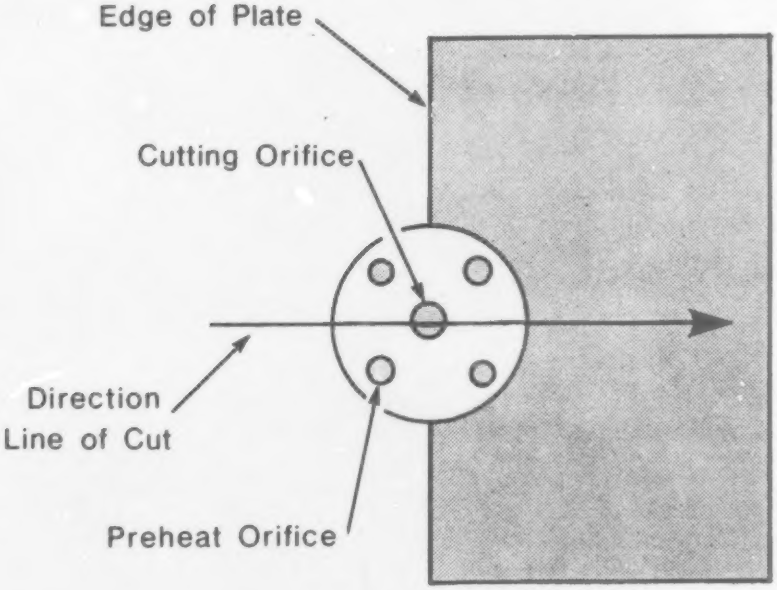
III. Tip alignment for square (straight) cutting

The tip should be installed in the cutting attachment as illustrated in figure 2.


Edge of Plate
Preheat Orifice
Direction
Line of Cut
Cutting Orifice

IV. Tip alignment for bevel cutting

The tip should be installed in the cutting attachment as illustrated in figure 3.

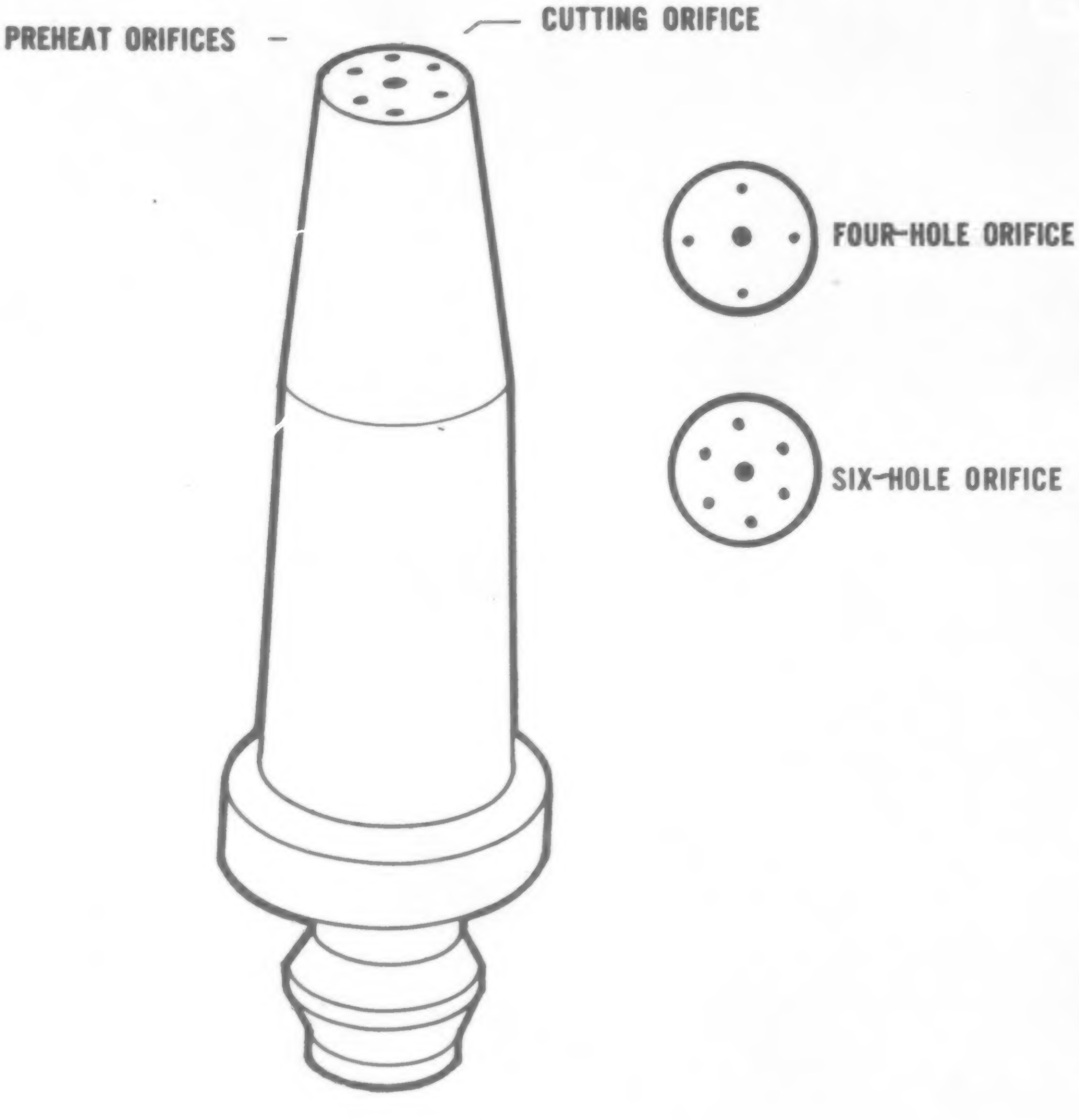

Edge of Plate
Cutting Orifice
Direction
Line of Cut
Preheat Orifice

V. Tip sizes compared to metal thickness

Tip Sizes Compared to Metal Thickness

TIP SIZE	METAL THICKNESS (inches)	OXYGEN PRESSURE (pounds)	ACETYLENE PRESSURE (pounds)
oo	1/64"	1	1
o	1/32"	1	1
1	1/16"	1	1
2	3/32"	2	2
3	1/8"	3	3
4	3/16"	4	4
5	1/4"	5	5
6	5/16"	6	6
7	3/8"	7	7
8	1/2"	8	8

TORCH TIPS


PREHEAT ORIFICES
CUTTING ORIFICE
FOUR-HOLE ORIFICE
SIX-HOLE ORIFICE

ASSIGNMENT SHEET 8--SELECTING CUTTING TIPS

I. Fill in the blank in the following statements:

A. The size of the cutting tip is determined by the __________ of the cutting orifice (center hole) which is marked on the tip.

B. The most common numbering system consists of numbers which range from _______ to _______.

C. The larger the cutting tip number, the greater the diameter of the ________ ________ (center hole).

D. The cutting orifice (center hole) is circled by the ___________ orifices.

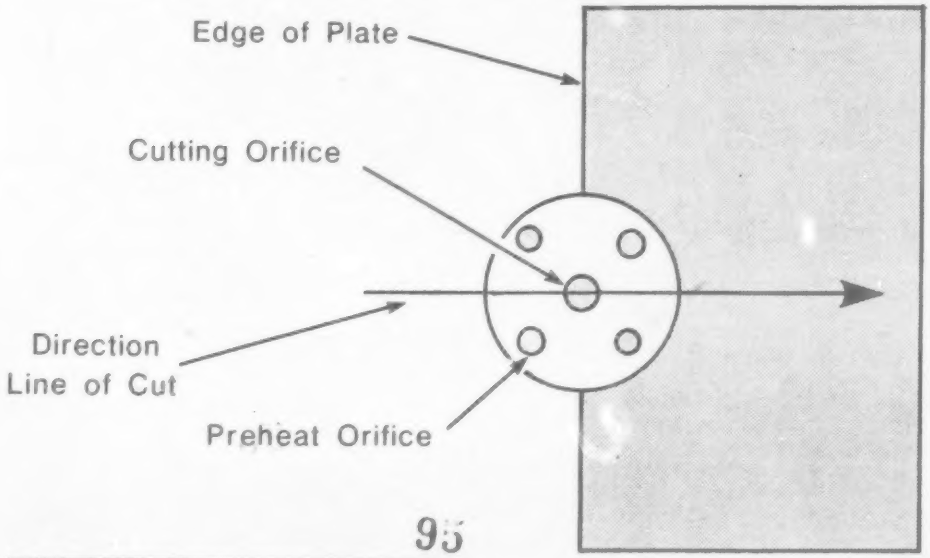
E. The size of the cutting tip selected will depend upon the ____________ of the metal to be cut.

F. As metal thickness ___________, the diameter of the cutting orifice (center hole) and the number on the tip becomes larger.

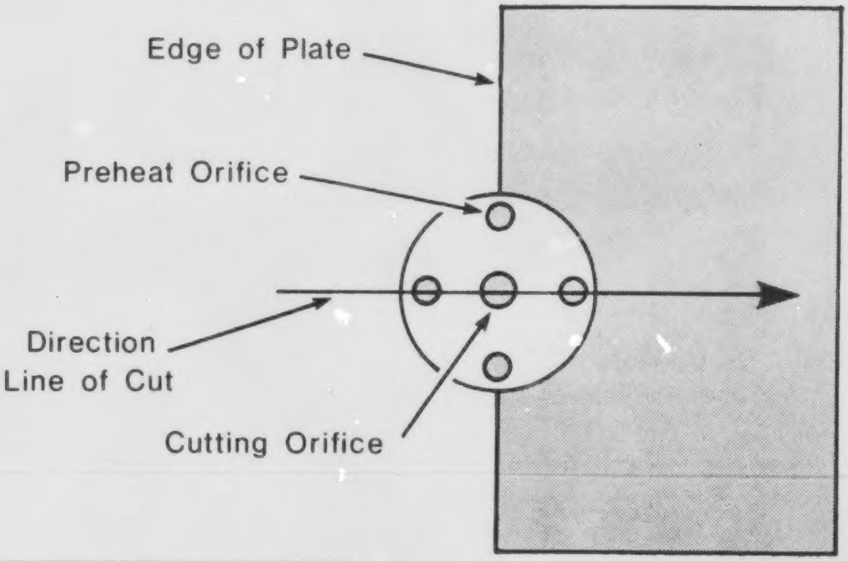
G. Too ___________ a cutting tip will make it very difficult and time consuming to cut.

H. Excessive melt and slag while consuming excessive oxygen and acetylene is caused by using too ___________ a tip.

II. Look at the following drawings and label each one as to the type of cut to make with the tip alignment. Write the answer in the blank provided under the drawing.



A. _________________________


Edge of Plate
Preheat Orifice
Direction
Line of Cut
Cutting Orifice

B. ____________________________

III. From the chart, determine the tip size for the following thickness of metal. Place the tip number in the blank left of the metal thickness.

1/2" ________

1/8" ________

3" ________

3/4" ________

1/4" ________

2" ________

1" ________

TIP SIZE	METAL THICKNESS (inches)	OXYGEN PRESSURE (pounds)	ACETYLENE PRESSURE (pounds)
000	1/8"	20-25	3-5
00	1/4"	20-25	3-5
0	3/8"-1/2"	25-30	3-5
1	3/4"	30-35	3-5
2	1"-1 1/2"	30-40	3-5
3	2"-2 1/2"	35-45	3-6
4	3	40-50	3-7
8	12"	45-55	10-14

WELDER'S HELPER

TEST--PART 2

I. I. Match the following terms and definitions:

____ A. Oxidizing

____ B. Tip cleaners

____ C. Preheat time

____ D. Oxides

____ E. Drag lines

____ F. Backfire

____ G. Preheat orifice

____ H. Flame cutting

____ I. Slag

____ J. Kerf

____ K. Flashback

1. A sudden burning of the flame back into the torch as the flame goes out with a pop

2. The process by which steel is removed by heating to the melting point and then rapidly oxidizing it with pure oxygen under pressure

3. Combining of oxygen with steel forming a scale or slag

4. The deposits or oxides left after a cut has been made

5. Rust, corrosion, scale coating, or slag

6. Area where metal was removed in the form of oxides during the cutting process

7. The lines formed on the metal being cut which appear to be lagging behind at the bottom of the cut

8. A fire burning inside the torch

9. Heating the metal at the starting point of cut to its melting temperature

10. A device used to combine the gases to produce a preheat flame

11. A device with different sized wires to remove carbon deposits from welding tips

II. Identify the parts of the torch body and cutting attachment by placing the correct number to the left of the letter.

_____ A. Torch body

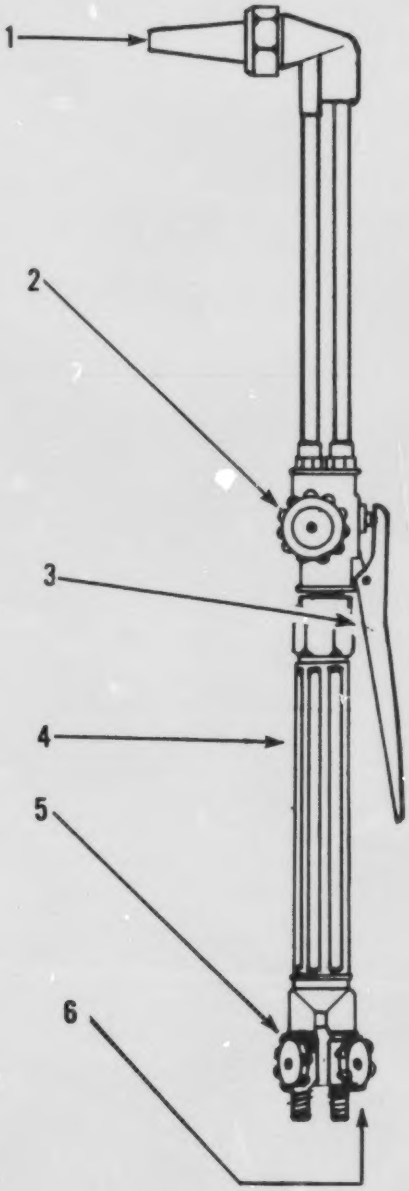
_____ B. Cutting tip

_____ C. Acetylene torch valve

_____ D. Cutting lever

_____ E. Oxygen torch valve

_____ F. Oxygen pre-heat valve



III. Point out the hazard of hot slag by answering yes or no to each of the following statements.

_____ A. Hot slag gives off radiation.

_____ B. Hot slag will cause burns to the body.

_____ C. Hot slag takes days to cool.

_____ D. Slag will burn hoses.

_____ E. Hot slag will cause concrete to explode.

_____ F. Hot slag causes fire on clothing.

IV. Place a "√" in front of any following phrases that identify causes of backfires.

_____ A. Moisture in the air

_____ B. Acetylene or oxygen pressure too low

_____ C. Cutting tip nut loose

_____ D. Overheating the cutting tip

_____ E. Improper weave pattern

_____ F. Faulty O-rings

_____ G. Rust or dirt on metal being welded

V. Describe the results of a backfire by circling the correct answer in each of the following.

A. The flame burns inside the tip (for hours, momentarily.)

B. There is usually a loud (pop, explosion.)

C. The flame sometimes (gets bigger, goes out.)

D. The flame may continue to burn (normally, out of control.)

VI. Describe the results of a flashback by circling the correct answer in each of the following.

A. A fire is burning (around the tip, inside the torch.)

B. The flame seems (to go out, to get larger.)

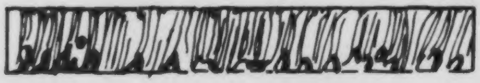
C. A squealing or hissing noise means the flashback is (over, beginning.)

D. Torch starts (smoking, shaking) and getting (hot, cold.)

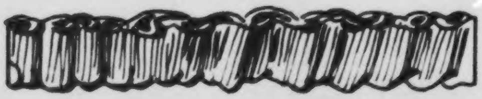
E. The torch will (quit burning, burn in half) if a flashback continues.

VII. Determine the reasons for poor torch cuts by placing the letter of the reason next to the correct torch cut illustration.

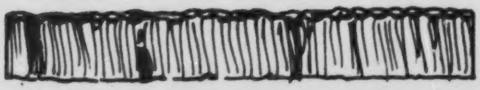
______ A.



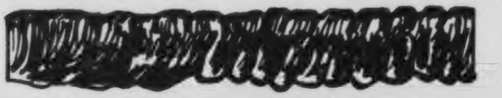
______ B.



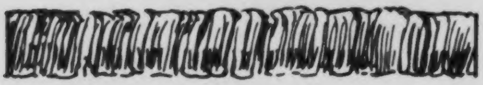
______ C.



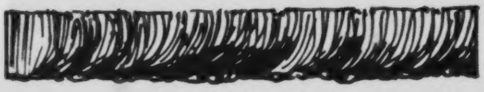
______ D.



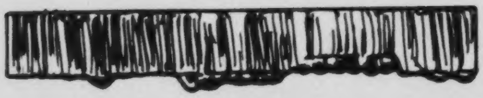
______ E.



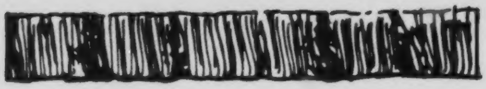
______ F.



______ G.



______ H.



1. Oxygen pressure too high
2. Unsteady torch movement
3. Cutting speed fast
4. Cutting speed slow
5. Cut stopped and started poorly
6. Oxygen pressure too low
7. Preheat flames too long
8. Preheat flames too small

VIII. Identify the statements below as TRUE or FALSE by writing the answer in the space at the left.

________A. The size of the cutting tip is determined by the number of preheat orifices.

________B. The larger the cutting tip number, the greater the diameter of the cutting orifice.

________C. The size of the cutting tip selected will depend upon the thickness of the metal to be cut.

________D. The most common system for marking the tip size is a letter such as A-K.

________E. The cutting orifice is circled by four or six preheat orifices.

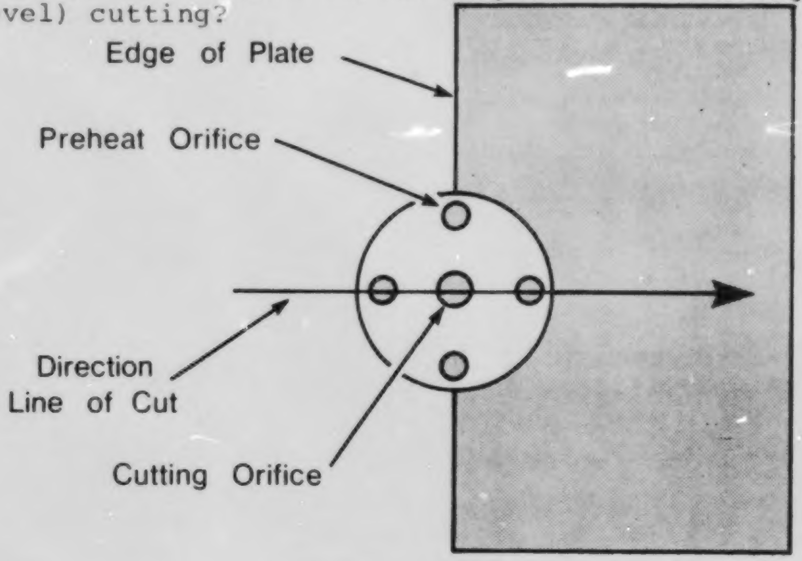
________F. As metal thickness decreases, the diameter of the cutting orifice (center hole) and the number of the tip become larger.

________G. If the cutting tip selected is too large, not enough heat will be produced for the cut.

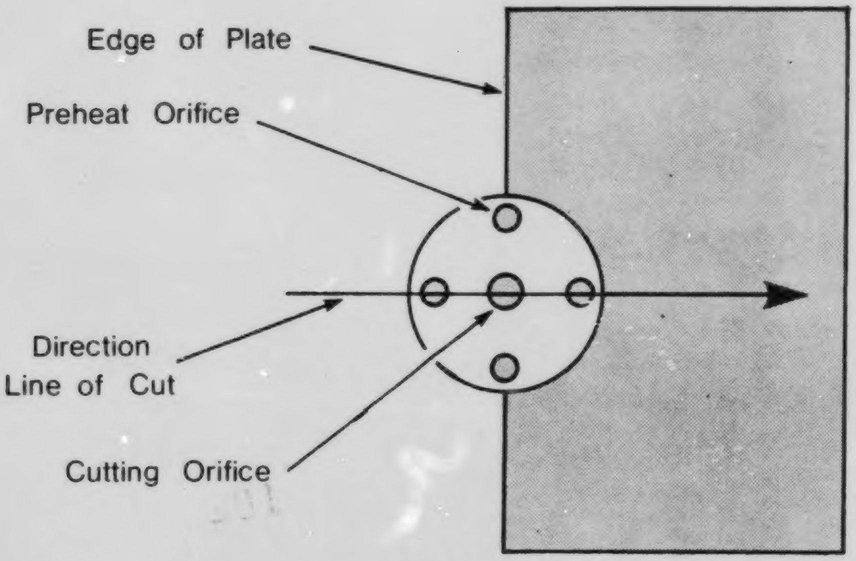
________H. Too small a cutting tip is difficult to cut with, and is time-consuming.

IX. Identify the correct tip alignment by circling the correct answer in each of the following:

A. The illustration in the drawing below is for (square or bevel) cutting?


Edge of Plate
Preheat Orifice
Direction
Line of Cut
Cutting Orifice

B. The illustration in the drawing below is for (square) (bevel) cutting? Underline the answer.


Edge of Plate
Preheat Orifice
Direction
Line of Cut
Cutting Orifice

X. From the chart below, select the correct tip size for the following thicknesses of metal. Place the tip number in the blank at the left of each metal thickness given.

A. ______ 1 1/2"

B. ______ 2 1/2"

C. ______ 3/4"

D. ______ 1/8"

E. ______ 3"

F. ______ 3/8"

G. ______ 1/4"

H. ______ 1"

TIP SIZE	METAL THICKNESS (inches)	OXYGEN PRESSURE (pounds)	ACETYLENE PRESSURE (pounds)
000	1/8"	20-25	3-5
00	1/4"	20-25	3-5
0	3/8"-1/2"	25-30	3-5
1	3/4"	30-35	3-5
2	1"-1 1/2"	30-40	3-5
3	2"-2 1/2"	35-45	3-6
4	3	40-50	3-7
8	12"	45-55	10-14

INFORMATION SHEET 9--HISTORY AND TERMINOLOGY OF ARC WELDING

I. History

A. Welding with an electric arc was developed at the end of the 19th century.

B. Electric arc welding was first used in 1881 by a French inventor to join the parts of a storage battery.

C. Introduction of arc welding into the U.S. failed because people were not aware of the possibilities it offered.

D. Carbon arc welding was patented in 1887 by a Russian inventor.

E. Coated welding rods were introduced in 1929.

F. Coatings were improved to keep out oxygen and nitrogen and to form a stronger weld.

II. Terms and definitions

A. Shielded metal arc welding--A welding process that joins metals by heating with an electric arc jumping from a coated electrode to the metal.

B. Arc--The flow of electric current from the tip of the electrode to the metal being welded.

C. Electrode--A bar of flux-coated rod that is melted into the metal being welded by heat from an electric arc.

D. Flux--A material that is used in brazing and welding to allow the molten metal to fuse to the metal being welded, and to keep out impurities.

E. Base metal--The metal to be welded.

F. Filler metal--Metal added to the weld to produce buildup.

G. Depositied metal--The buildup of a metal on the weld.

H. Crater--The depression at the end of a weld.

I. Arc length--The distance from the end of the rod to the base metal being welded.

J. AC (alternating current) Welder--A unit for welding in which the current changes direction 120 times a second.

K. DC (direct current) Welder--A unit for welding in which the current travels in one direction only.

L. Amperage--The measurement used for electric current.

M. AWS--American Welding Society.

ASSIGNMENT SHEET 9--HISTORY AND TERMINOLOGY OF ARC WELDING

I. Write the term in the blank to the left that best describes the definition given.

AWS
Arc length
Electrode
DC welder
Amperage
Crater
AC welder
Base metal
Filler metal
Flux
Deposited metal
Arc
Shielded metal arc welding

__________ A. A welding process that joins metal by heating with an electric arc jumping from a coated electrode to the metal

__________ B. The flow of electric current from the tip of the electrode to the metal

__________ C. A bar of flux-coated rod that is melted into the metal being welded by heat from an electric arc

__________ D. A material that is used in brazing and welding to allow the molten metal to fuse to the metal being welded and to keep out impurities

__________ E. The metal to be welded

__________ F. Metal added to the weld to produce buildup

__________ G. The buildup of a metal on the weld

__________ H. The depression at the end of a weld

__________ I. Distance from the end of the rod to the base metal being welded

__________ J. A unit for welding in which the current changes direction 120 times a second

__________ K. A unit for welding in which the current travels in one direction only

__________ L. The measurement for electric current

__________ M. American Welding Society

II. Discuss briefly the history of shielded metal arc welding.

INFORMATION SHEET 10-THE ARC WELDER AND EQUIPMENT

I. Types of Welders

  A. AC Welder--A transformer-type of welder producting alternating current

  B. DC Welder--A motor or engine driven generator producing direct current

  C. AC-DC Welder--A transformer rectifier producing either type of current

II. Welding machine adjustments

  A. Current setting (amperage)

    1. Increases amperage to produce more heat

    2. Decrease amperage to produce less heat

  B. Polarity

    1. Reverse polarity allows current to flow from base metal (-) to electrode (+)

    2. Straight polarity allows current to flow from electrode (-) to base metal (+)

III. Special uses for the arc welder

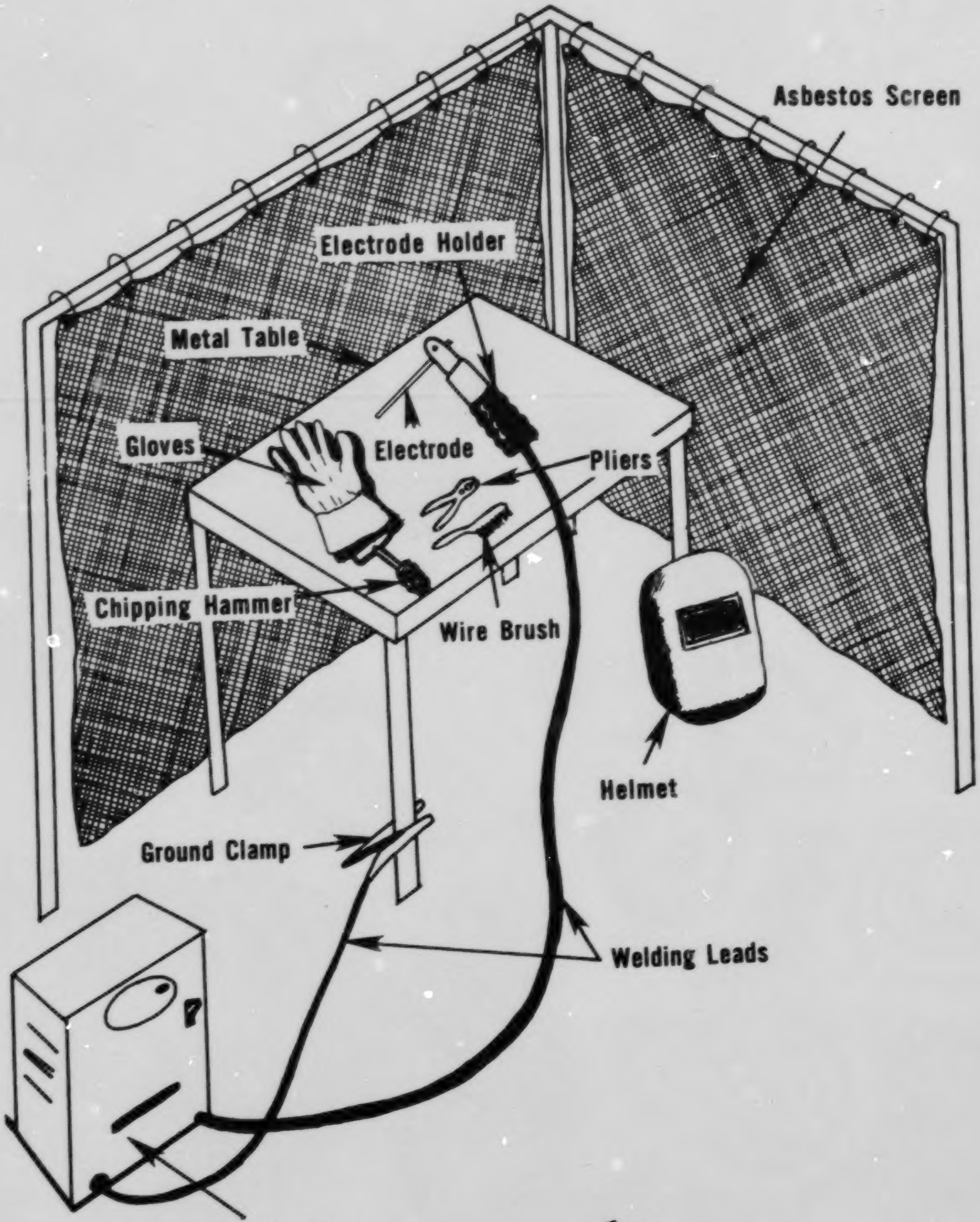
  A. Cutting can be done with special rods

  B. Hole piercing

  C. Gouging or removing metal

  D. Beveling metal edges

IV. Arc Welding Equipment

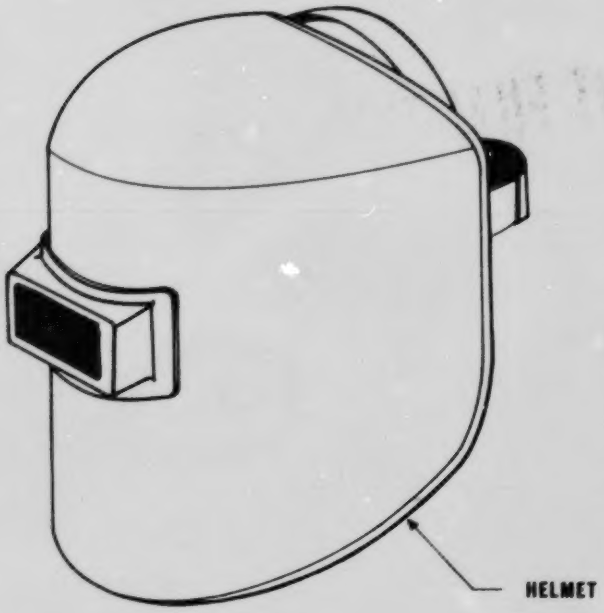

Asbestos Screen
Electrode Holder
Metal Table
Gloves
Electrode
Pliers
Chipping Hammer
Wire Brush
Helmet
Ground Clamp
Welding Leads
Arc Welder

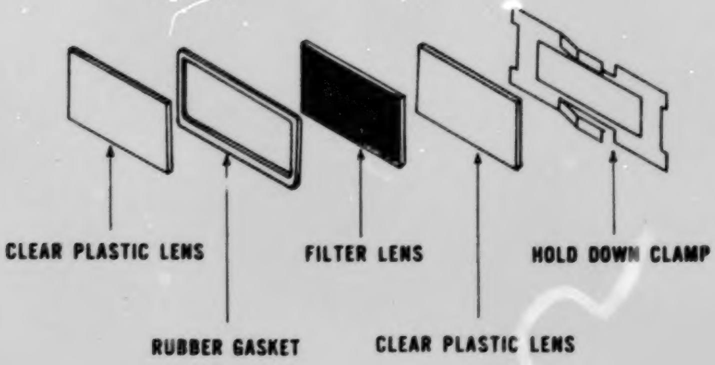
V. Welding lens

   A. Colored lens (#10 lens is recommended)

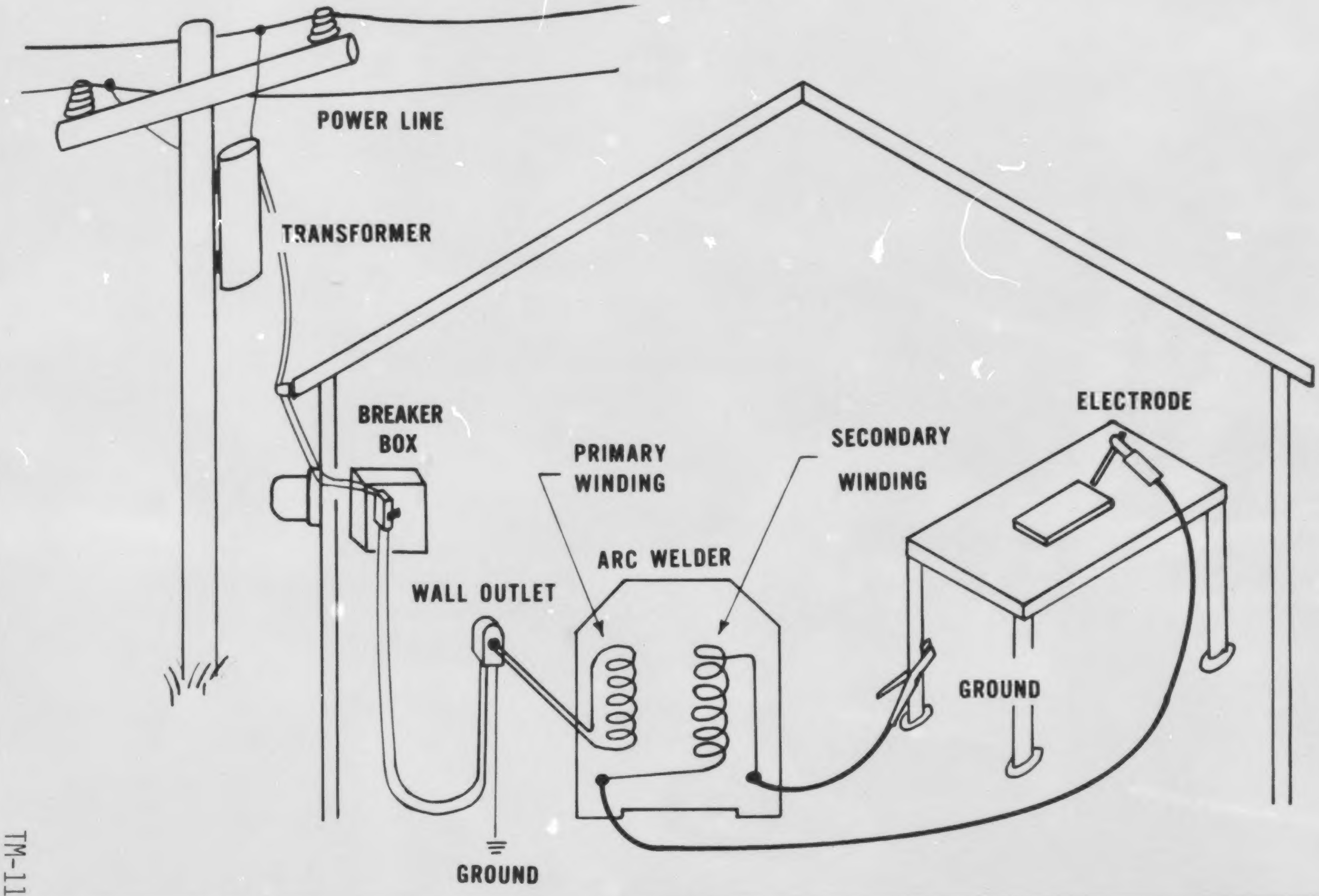
   B. Clear, plastic or glass

   EXAMPLE:



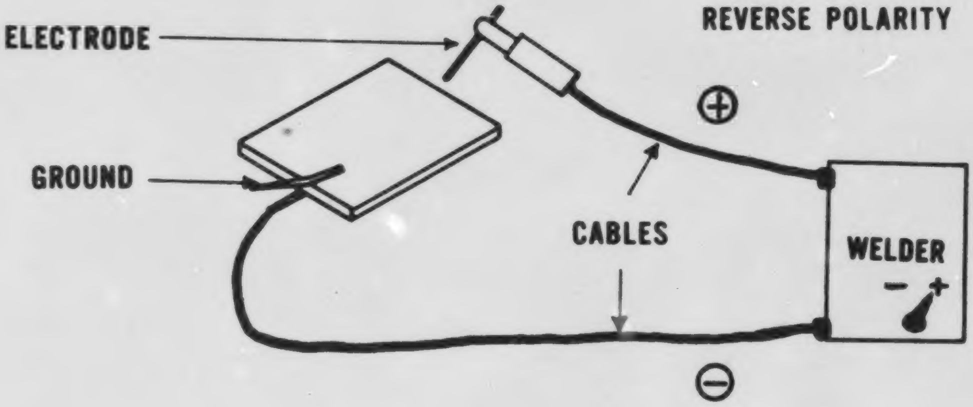

CLEAR PLASTIC LENS
RUBBER GASKET
FILTER LENS
CLEAR PLASTIC LENS
HOLD DOWN CLAMP

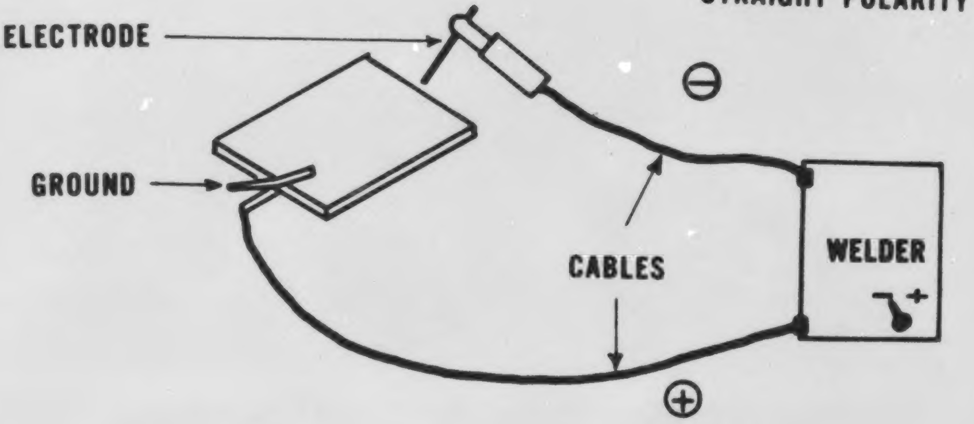
AC WELDER


POWER LINE
TRANSFORMER
BREAKER BOX
PRIMARY WINDING
SECONDARY WINDING
ELECTRODE
ARC WELDER
WALL OUTLET
GROUND
GROUND

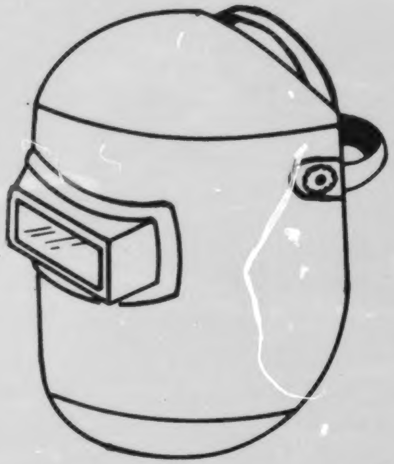
TM-11

DC POLARITY

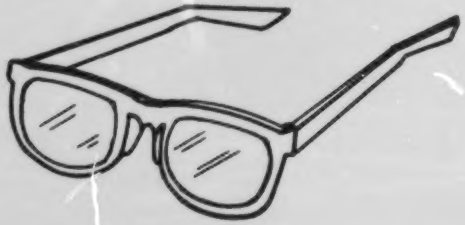

REVERSE POLARITY
ELECTRODE
GROUND
CABLES
WELDER
−
+
⊕
⊖


STRAIGHT POLARITY
ELECTRODE
GROUND
CABLES
WELDER
+
⊖
⊕

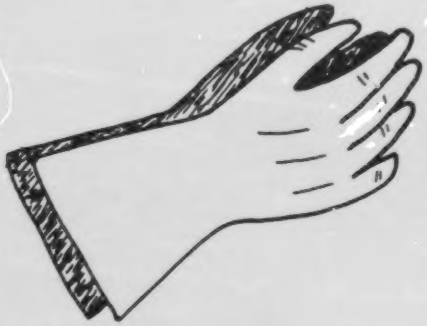
WELDING EQUIPMENT



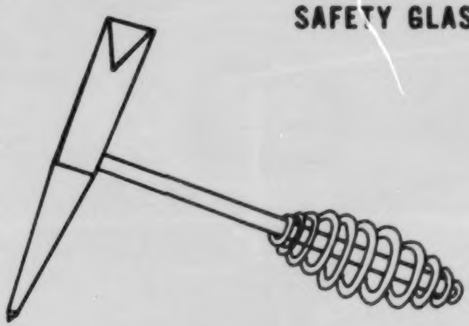
HELMET



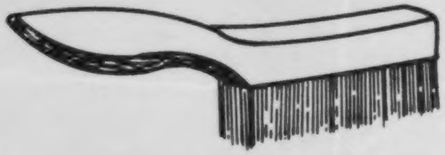
SAFETY GLASSES



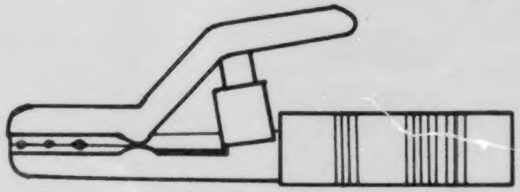
GLOVES



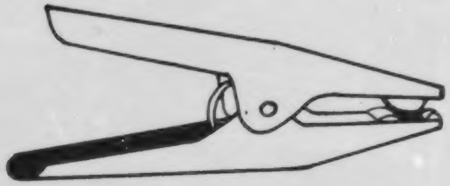
CHIPPING HAMMER



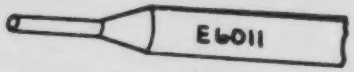
WIRE BRUSH



ELECTRODE HOLDER



GROUND CLAMP

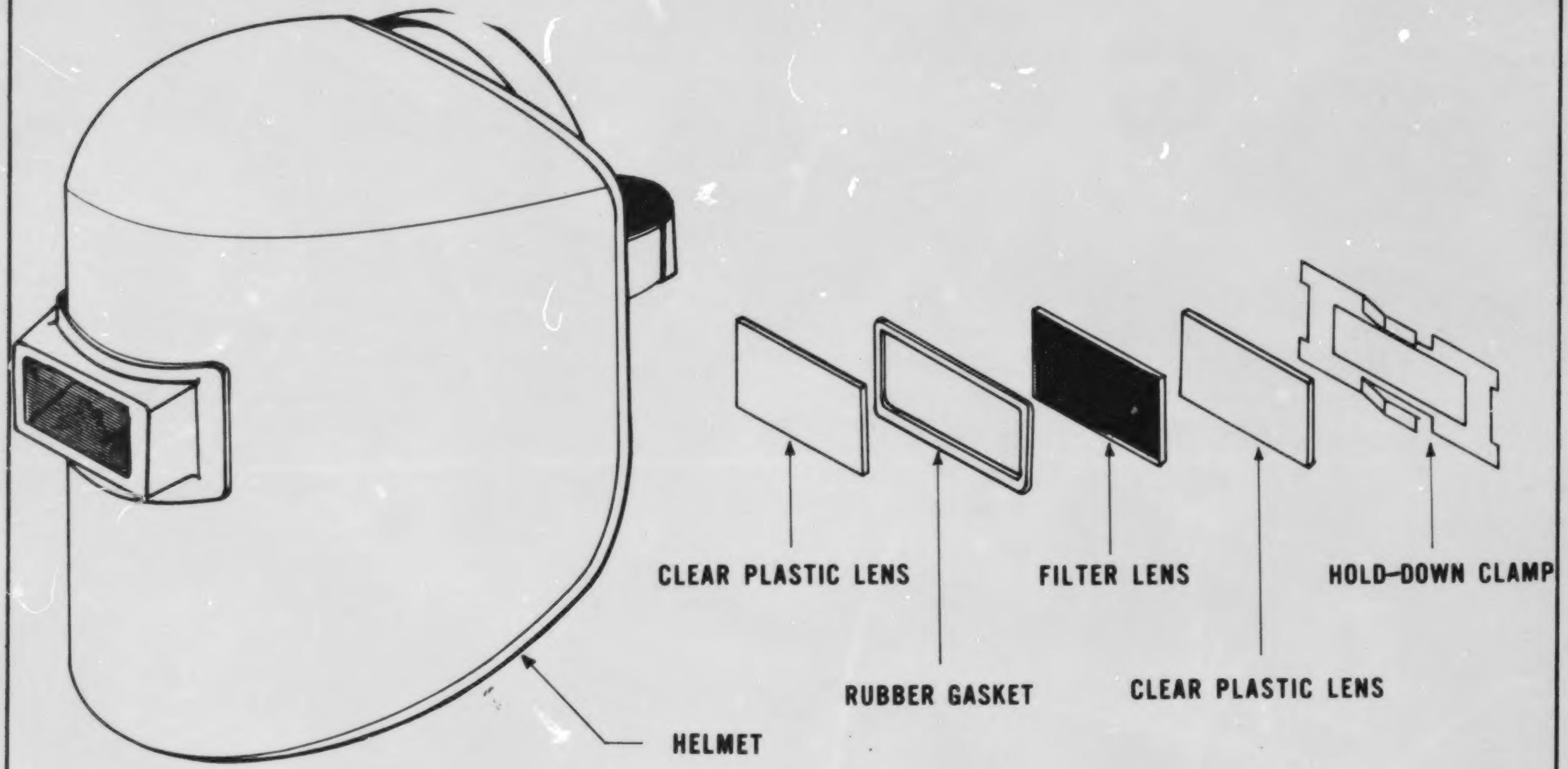


ELECTRODE

TM-13

81

HELMET LENS INSTALLATION


CLEAR PLASTIC LENS
RUBBER GASKET
FILTER LENS
CLEAR PLASTIC LENS
HOLD-DOWN CLAMP
HELMET

TM-14

ASSIGNMENT SHEET 10-THE ARC WELDER AND EQUIPMENT

I. List the three types of arc welders:

A.

B.

C.

II. Circle the T if the statement is true or F if the statement is false.

A. Decrease amperage to produce more heat (T or F)

B. Increase amperage to produce more heat (T or F)

C. Reverse polarity allows current to flow from electrode to base metal (T or F)

D. Straight polarity allows current to flow from base metal to electrode (T or F)

III. List four special uses for the arc welder:

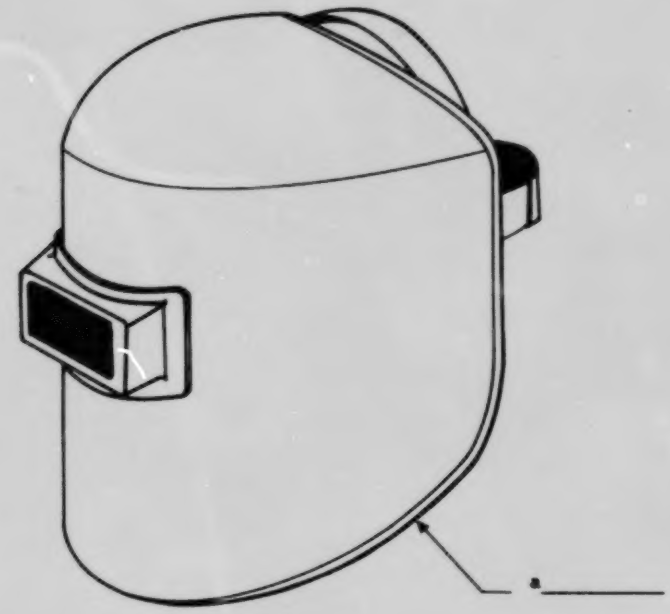
A.

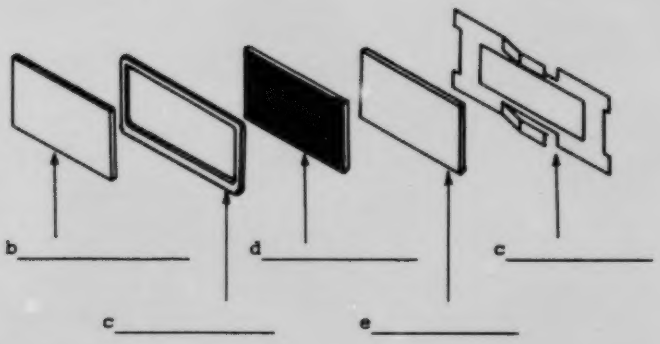
B.

C.

D.

IV. Label the parts of the welding lens assembly.





WELDER'S HELPER

INFORMATION SHEET 11-ARC WELDING SAFETY

I. Safety

  A. Electrical shock

    1. Properly ground the arc welder
    2. Keep the welder in a cool, dry location
    3. Do not leave cables where they can be run over by other equipment or machinery
    4. When welding, do not stand on wet surfaces or in water
    5. Use electrode holders that are well insulated and free from cracks
    6. Wear leather gloves that are in good condition

  B. Radiation

    1. The face and eyes should be covered with an arc welding helmet or shield
    2. Any exposed skin surface should be covered to prevent burns from the ultraviolet and infrared rays
    3. A verbal warning should be given to all persons in the area before striking an arc
    4. Examine the helmet for cracks that will allow light to enter
    5. Replace any cracked helmet lens
    6. Do not wear oxyacetylene goggles when arc welding

  C. Protective clothing

    1. Wear high-top shoes
    2. Do not wear pants with cuffs
    3. Shirts should have long sleeves and button-up collars
    4. Wear welding gloves of leather
    5. Leather welding sleeves should be worn when available
    6. Leather aprons should be worn when available
    7. Safety glasses should be worn when chipping or cleaning

the welds

D. Fumes and gases

1. Toxic gases are formed when welding galvanized metal
2. Fans or adequate ventilation should be used to eliminate these gases
3. Avoid welding on containers or metal that have contained chemicals or been painted

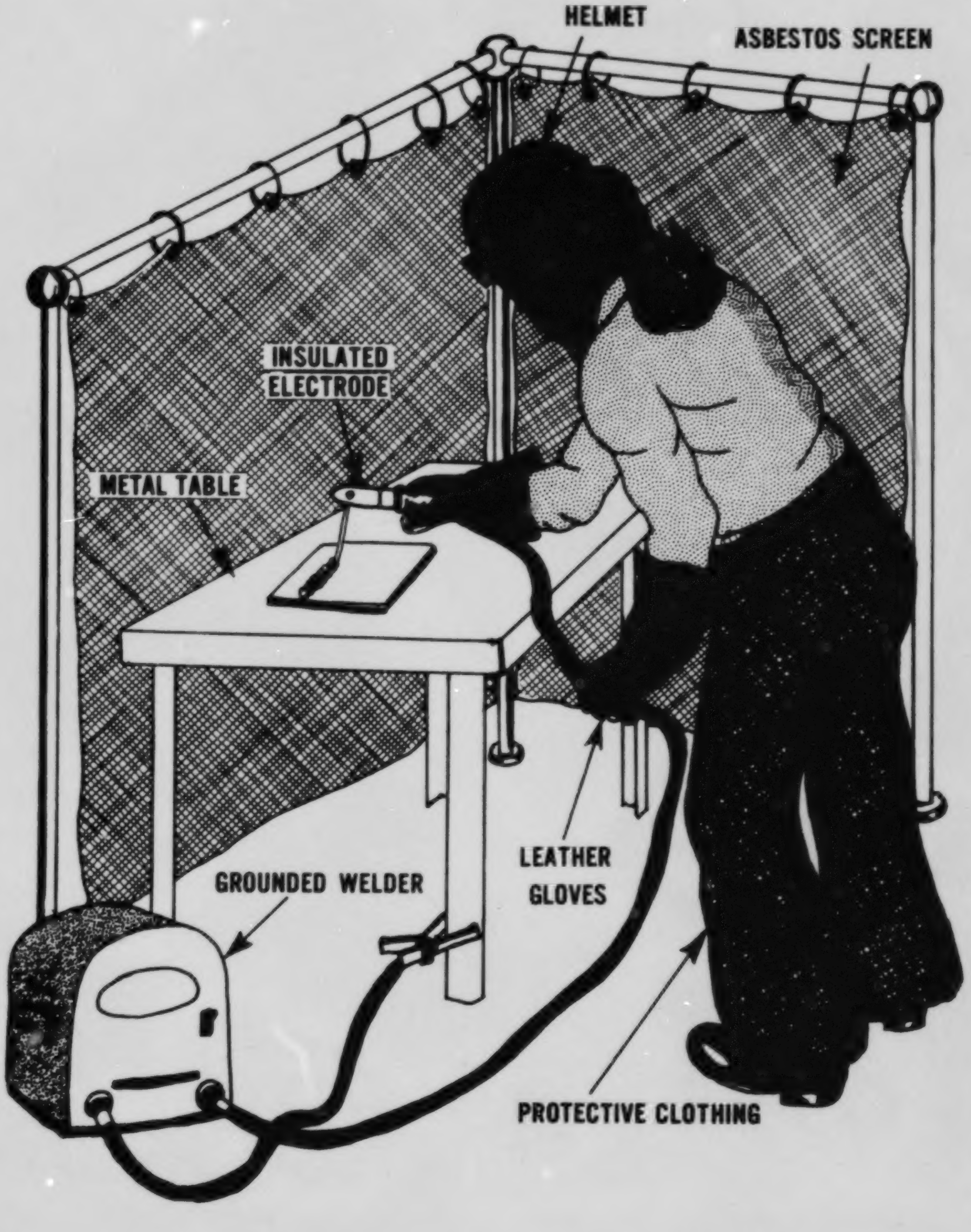
E. Combustable materials

1. Remove all oily rags or greasy materials from the welding area
2. Do not weld on containers that have held a combustable substance

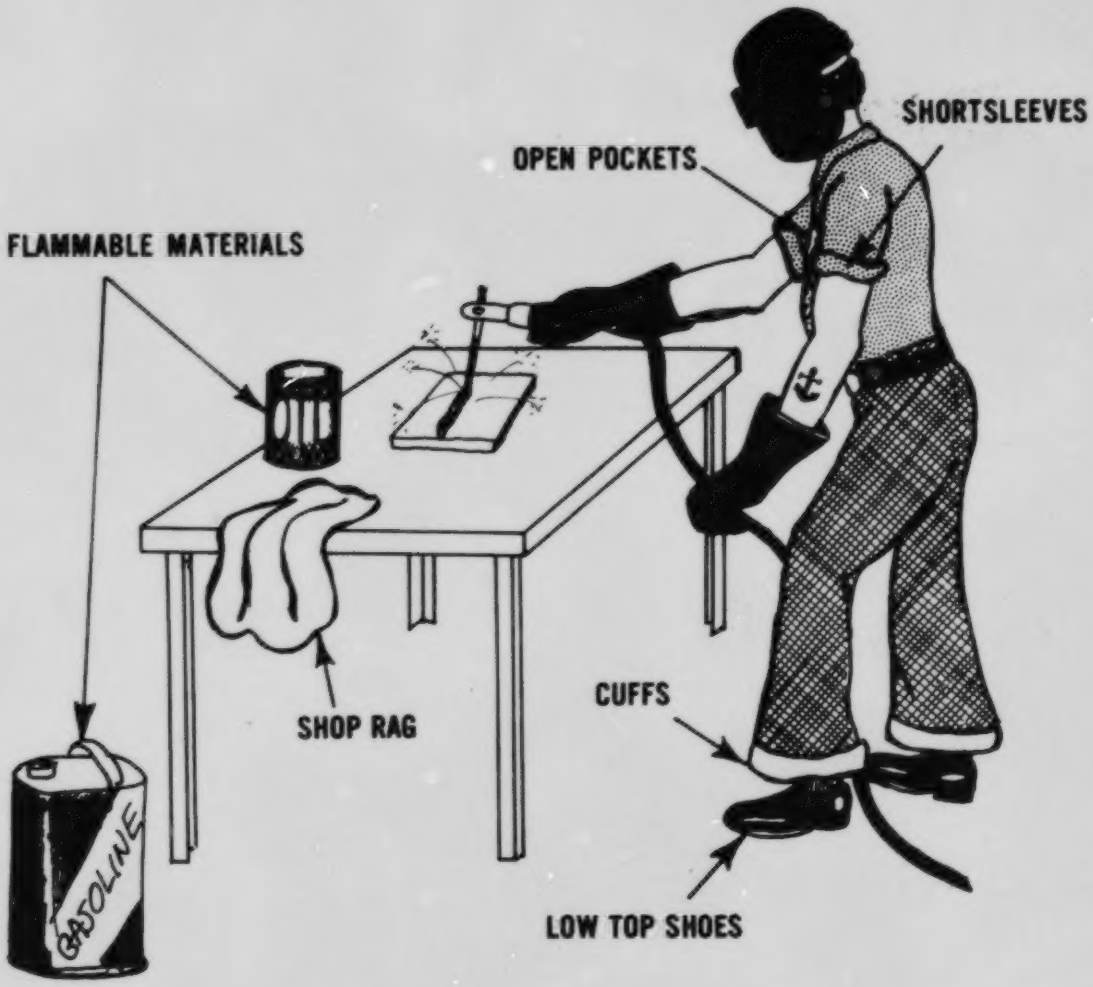
F. Hot metals

1. Handle hot metal with pliers
2. Stand to one side when dropping hot metal into a cooling vat because hot steam will be given off
3. Molten metal splatter from welding can cause serious burns if skin is not properly protected

PROTECTIVE EQUIPMENT

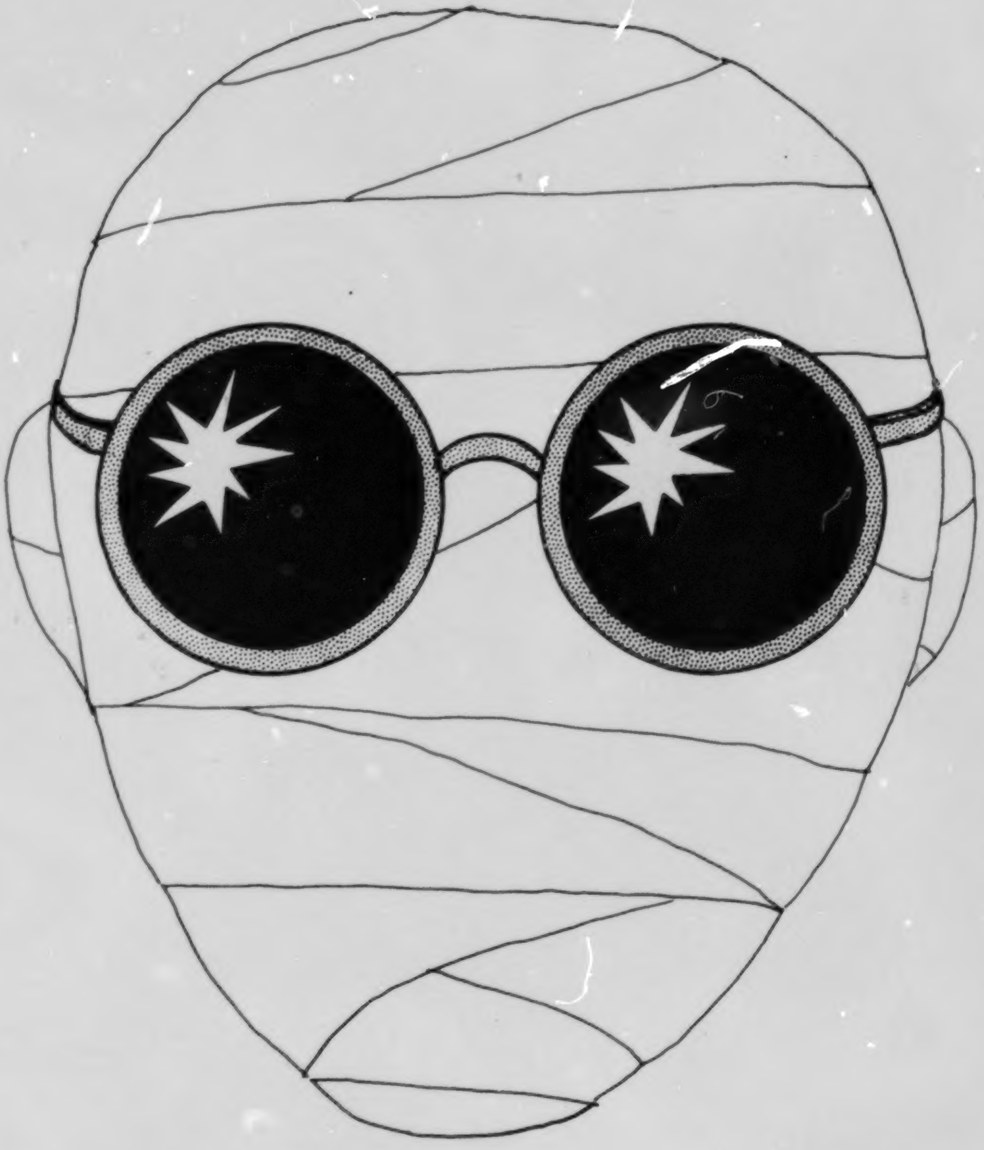

HELMET
ASBESTOS SCREEN
INSULATED ELECTRODE
METAL TABLE
GROUNDED WELDER
LEATHER GLOVES
PROTECTIVE CLOTHING

WELDING SAFETY


SHORTSLEEVES
OPEN POCKETS
FLAMMABLE MATERIALS
OIL
SHOP RAG
CUFFS
GASOLINE
LOW TOP SHOES

PROBLEM AREAS IN WELDING

ARC WELDING RADIATION CAN BURN!



Always Use A Welding Helmet or Shield

ASSIGNMENT SHEET 11-ARC WELDING SAFETY

I. List four safety practices to prevent electrical shock:

A.

B.

C.

D.

II. List four safety practices related to radiation:

A.

B.

C.

D.

III. List four safety practices which have to do with protective clothing:

A.

B.

C.

D.

IV. Record two ways dangerous fumes and gases can be produced when arc welding:

A.

B.

V. What steps should be taken to safely handle combustable materials?

A.

B.

VI. When working with hot metal, one should pay attention to several factors, list two:

A.

B.

INFORMATION SHEET 12-THE ELECTRODE

I. Types of electrodes

  A. Mild steel

  B. Low hydrogen

  C. Stainless steel

  D. Cast iron

  E. Hard surfacing

  F. Non-ferrous

II. Electrode Classification

  A. Standardized by the AWS (American Welding Society)

  (EXAMPLE: E plus four numbers E-6011 or E plus five numbers E-10018)

  B. E stands for electrodes for electric arc welding

  C. The first two digits of a four digit number or the first three digits of a five digit number represents the tensil strength of the deposited metal

    1. 60 would indicate a minimum of 60,000 psi tensil strength

    2. 100 would indicate a minimum of 100,000 psi tensil strength

  D. The third digit of a four digit number or the fourth digit of a five digit number indicates the welding position

    1. A number 1 here indicates all positions

    2. A number 2 here indicates flat positions only

    (NOTE: horizontal or downhand)

  E. The fourth digit of a four digit number or the fifth digit of a five digit number digit indicates special characteristics of the electrode

  (NOTE: Refer to a pocket guide for specifications)

    1. Current used

      a. AC

b. DC straight

c. DC reverse

2. Type of flux coating

3. Penetration

III. Electrode sizes

A. Determined by the diameter of the metal core wire

B. Range from 1/32 to 5/16 inch in thirty seconds

C. Common sizes 1/16, 3/32, 1/8, 5/32, 3/16, 7/32, 5/16 inch

IV. Purposes of flux

A. Keeps air out of the molten puddle

B. Allows weld to cool more slowly, which makes the weld stronger

C. Removes impurities from weld puddle

D. Stabilizes the arc

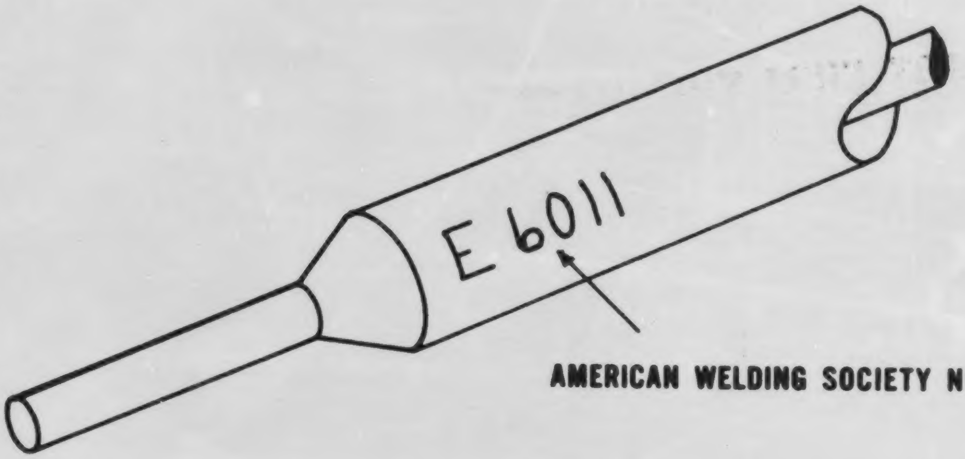
E. Prevents porousness of weld metal

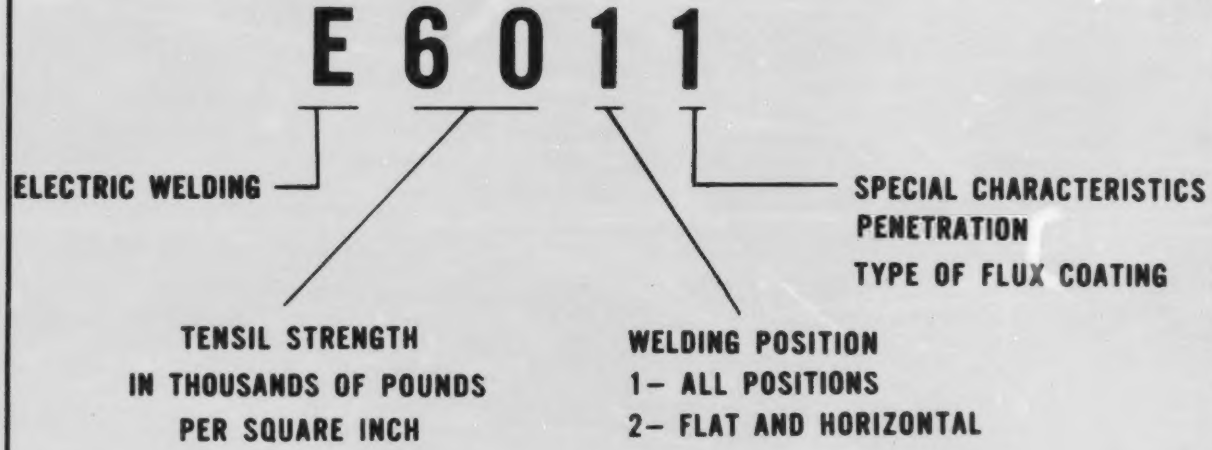
F. Adds alloys to weld metal for strength

G. Allows a faster deposit rate

H. Permits better penetration

ELECTRODE CODING


E 6011
AMERICAN WELDING SOCIETY NUMBER



E 6 0 1 1

ELECTRIC WELDING

TENSIL STRENGTH
IN THOUSANDS OF POUNDS
PER SQUARE INCH

WELDING POSITION
1- ALL POSITIONS
2- FLAT AND HORIZONTAL

SPECIAL CHARACTERISTICS
PENETRATION
TYPE OF FLUX COATING

ASSIGNMENT SHEET 12-THE ELECTRODE

I. Name the six basic types of electrodes:

A.

B.

C.

D.

E.

F.

II. Explain the numbering system for an electrode according to standards set by the American Welding Society (AWS).

III. Give the following information on electrodes by filling in the blanks.

A. Electrode size is determined by the ____________ of the metal core wire.

B. Electrode sizes range from 1/32 to ______ inch in thirty seconds.

C. Common sizes for electrodes are: 1/16, ____, 1/8, ____, 3/16, ____, 5/16, ____.

IV. List four purposes of the flux:

A.

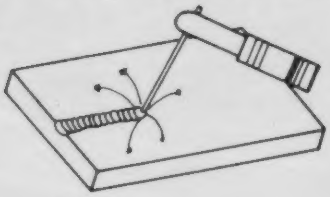
B.

C.

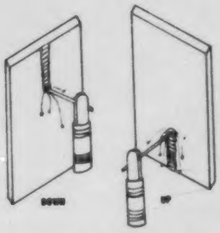
D.

INFORMATION SHEET 13-WELDING TERMINOLOGY

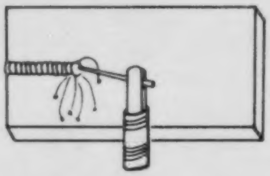
I. Welding positions



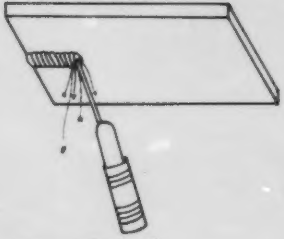
Flat



Vertical

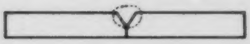


Horizontal

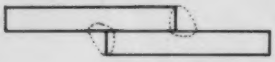


Overhead

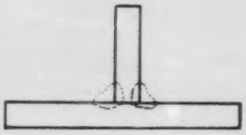
II. Weld Joints



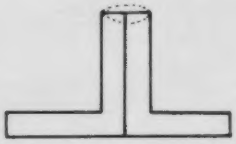
Butt Joint



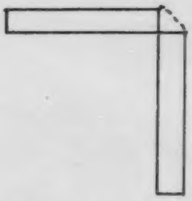
Lap Joint



Tee Joint

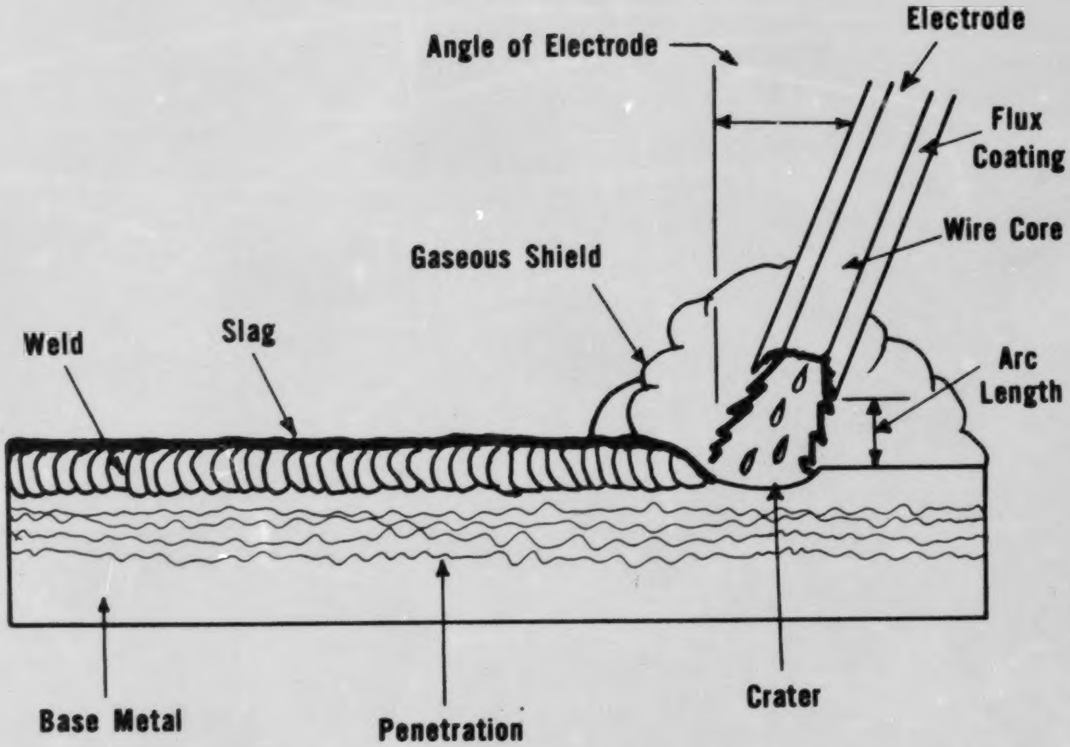


Edge Joint

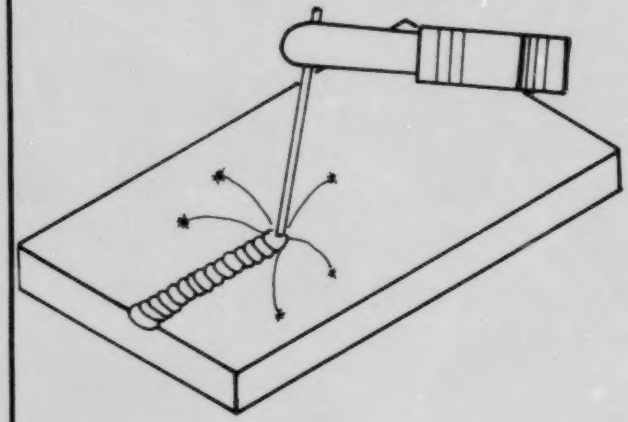


Corner Joint

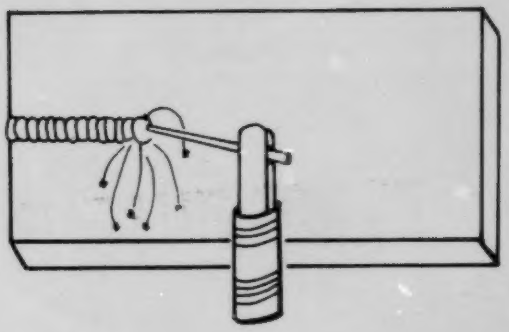
III. Terms associated with the welding process


Angle of Electrode
Electrode
Flux Coating
Wire Core
Gaseous Shield
Weld
Slag
Arc Length
Base Metal
Penetration
Crater

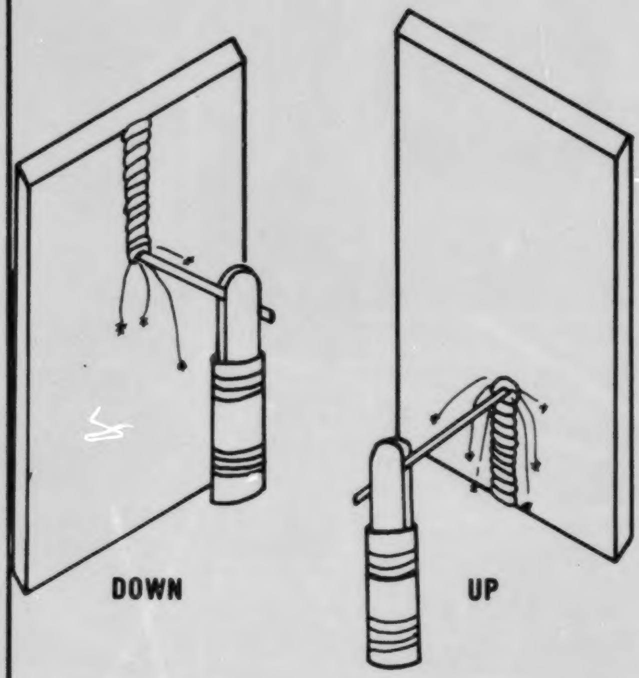
WELDING POSITIONS



FLAT



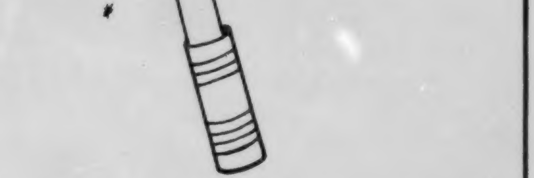
HORIZONTAL



DOWN

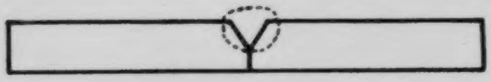
UP

VERTICAL

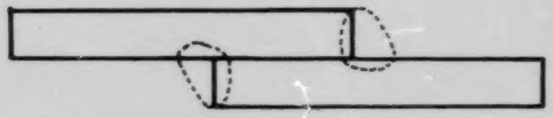


OVERHEAD

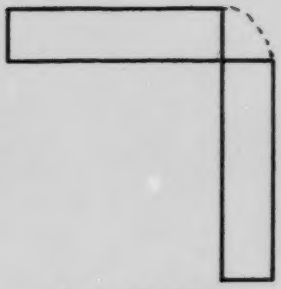
JOINTS AND WELDS



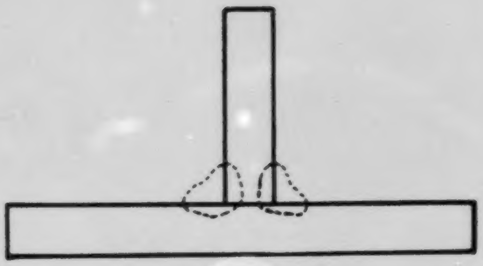
BUTT JOINT



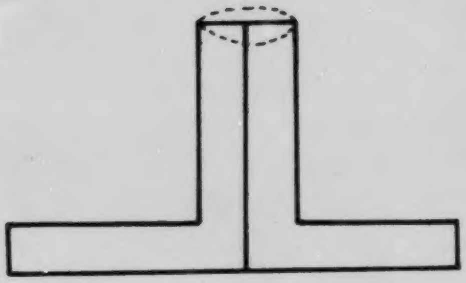
LAP JOINT



CORNER JOINT

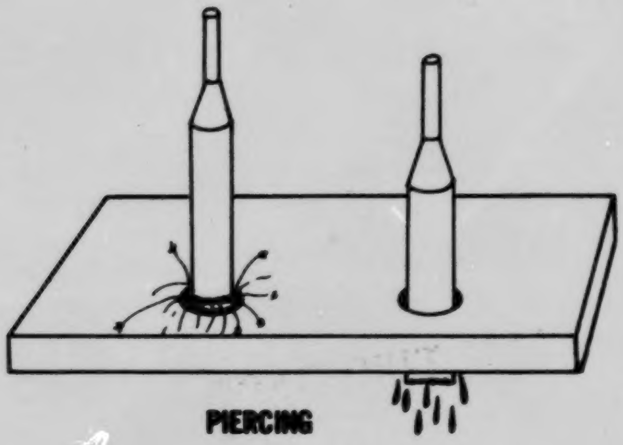


TEE JOINT

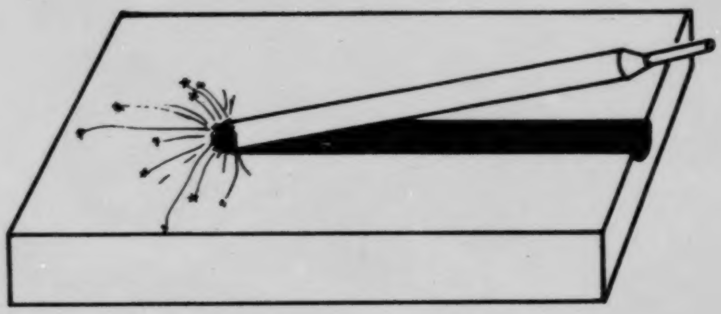


EDGE JOINT

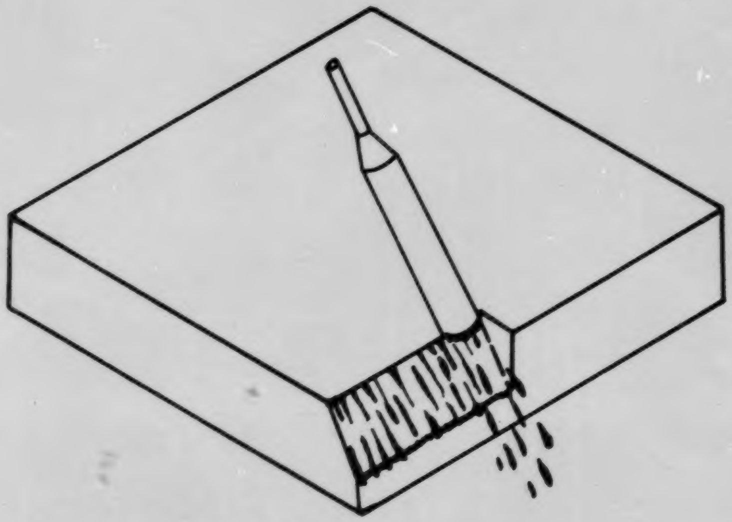
PIERCING, GOUGING, AND BEVELING



PIERCING



GOUGING



BEVELING

WELDER'S HELPER

ASSIGNMENT SHEET 13-WELDING TERMINOLOGY

I. List the four basic welding positions

A.

B.

C.

D.

II. Name the five common joints used in arc welding

A.

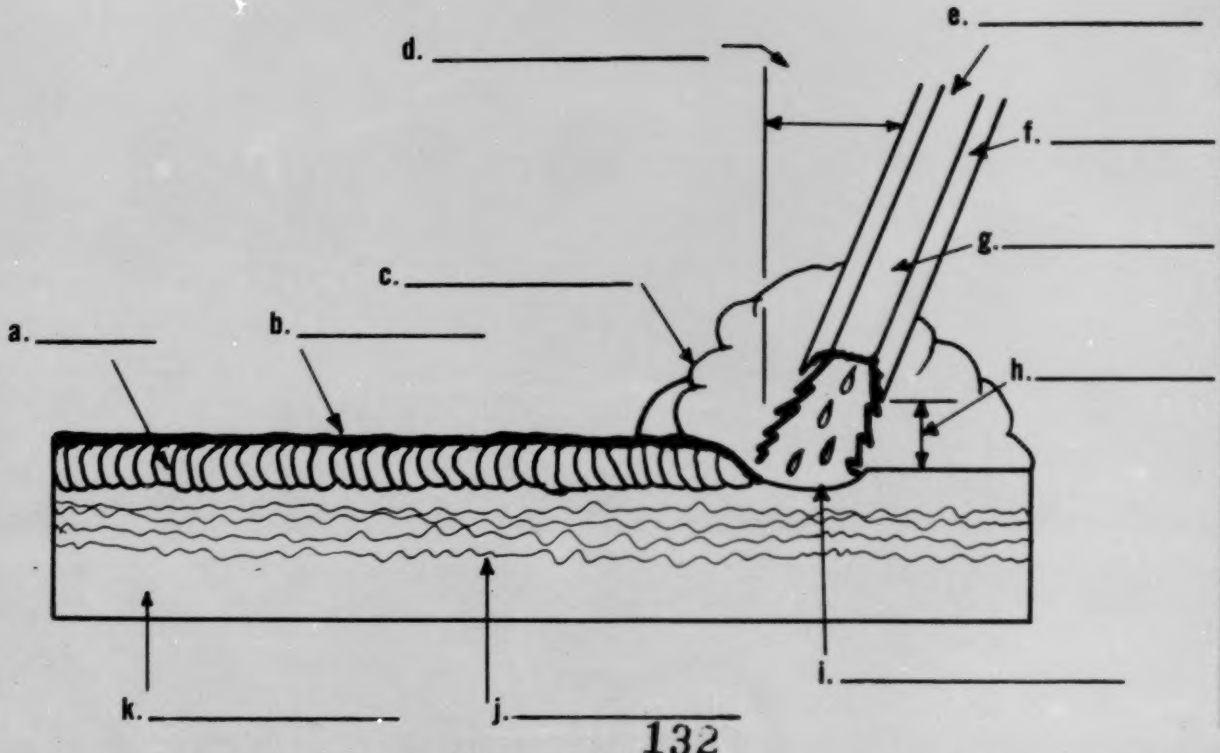
B.

C.

D.

E.

III. Name the terms associated with the welding process in the drawing below:



INFORMATION SHEET 14-WELD TYPES

I. Weld types defined

A. Surfacing weld--Made up of one or more stringer or weave beads deposited on an unbroken surface to obtain desired properties or dimensions.

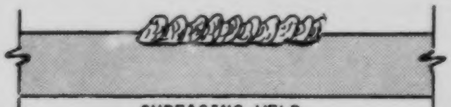
(EXAMPLE: Metal deposited for hardfacing or to buildup a worn part)

B. Fillet weld--Joins two pieces of metal at right angles of each other such as in a T, corner or lap joint. Weld is approximately a triangle in cross section.

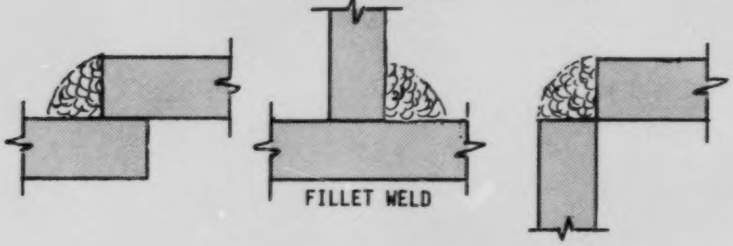
C. Groove weld--Weld made in a groove between two pieces of metal.

D. Plug and slot weld--Used to join two overlapping pieces of metal through circular holes or slots. Sometimes used instead of riveting the pieces together.

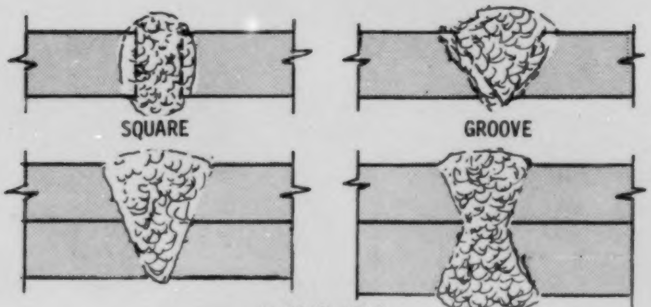
II. Weld types



SURFACING WELD

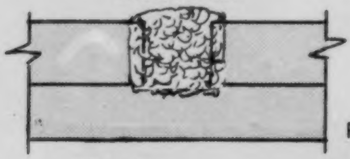


FILLET WELD



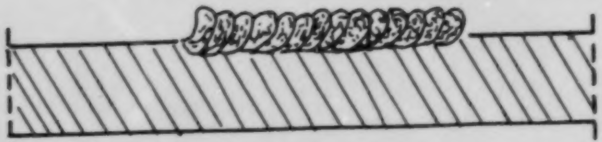
SQUARE GROOVE

GROOVE WELD

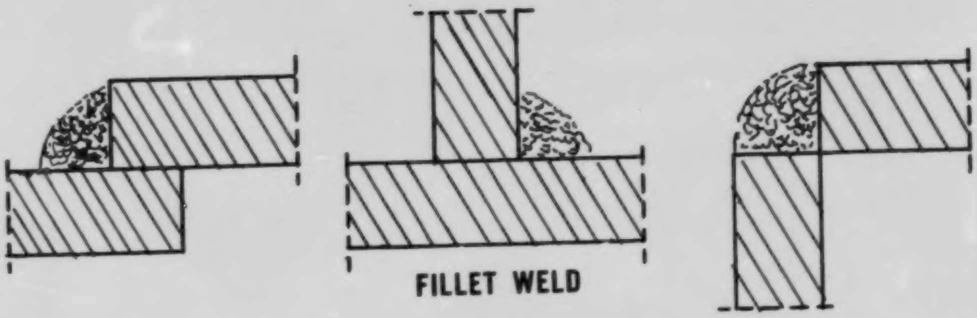


PLUG AND SLOT

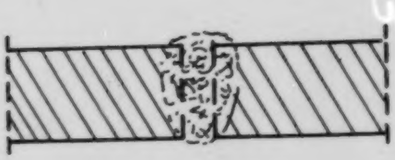
TYPES OF WELDS



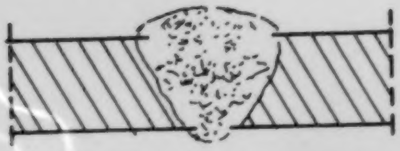
SURFACING WELD



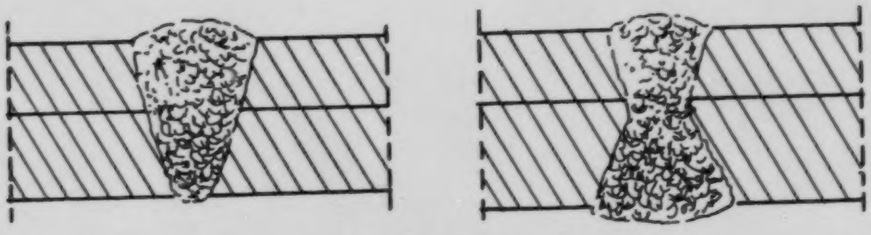
FILLET WELD



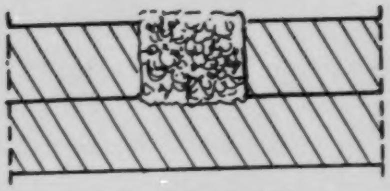
SQUARE



GROOVE



GROOVE WELD



PLUG AND SLOT

ASSIGNMENT SHEET 14-WELD TYPES

I. List and define the four weld types used in arc welding:

A.

B.

C.

D.

WELDER'S HELPER

TEST--PART 3

1. ______ A. A welding process that joins metals by heating them with an electric arc jumping from a coated electrode to the metal

______ B. The flow of electric current from the tip of the electrode to the metal being welded

______ C. A bar of flux-coated rod that is melted into the metal being welded, using heat from an electric arc

______ D. A material that is used in brazing and welding to allow the molten metal to fuse to the metal being welded, and to keep out impurities

______ E. The metal being welded

______ F. Metal added to the weld to produce buildup

______ G. The buildup of metal on the weld

______ H. The depression at the end of a weld

______ I. Distance from the end of the rod to the base metal being welded

______ J. A unit for welding in which current changes direction 120 times a second

______ K. A unit for welding in which the current travels in one direction only

______ L. The measurement for electric current

______ M. American Welding Society

1. AC (Alternating current) welder
2. DC (Direct current) welder
3. Crater
4. Base Metal
5. AWS
6. Shielded metal arc welding
7. Flux
8. Electrode
9. Amperage
10. Arc
11. Deposited metal
12. Filler metal
13. Arc length

2. Discuss briefly the history of shielded metal arc welding:

3. Identify three types of arc welders by filling in the correct term in each blank from the list below.

_______________ A. A transformer type of welder producing alternating current

_______________ B. A motor or engine-driven generator procucing direct current

_______________ C. A transformer rectifier producing either type of current

Carbon-arc welder

AC welder

Oxyacetylene welder

AC-DC welder

DC welder

4. Explain the effect of current setting by filling in the correct term in each blank from the list below.

_______________ A. Amperage to produce more heat

_______________ B. Amperage to produce less heat

_______________ C. Polarity allows current to flow from base metal (-) to electrode (+)

_______________ D. Polarity allows current to flow from electrode (-) to base metal (+)

Straight

Decrease

Increase

Reverse

5. Select special uses of the arc welder by answering YES to those of the following statements that are proper uses.

_____ A. Cutting can be done with special rods

_____ B. Brazing of cast iron

_____ C. Hole piercing

_____ D. Gauging or removing metal

_____ E. Soldering

_____ F. Beveling metal edges

6. Identify each of the parts of arc welding equipment by placing the number of the part in the blank to the left of the correct name.

_____ A. Arc welder

_____ B. Welding helmet

_____ C. Leather gloves

_____ D. Electrode holder

_____ E. Welding leads

_____ F. Chipping hammer

_____ G. Wire brush

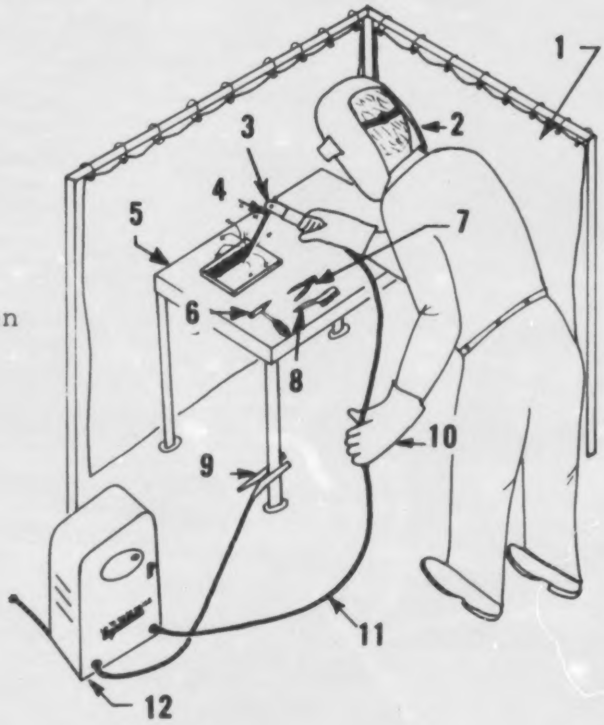
_____ H. Metal table

_____ I. Electrode

_____ J. Ground clamp

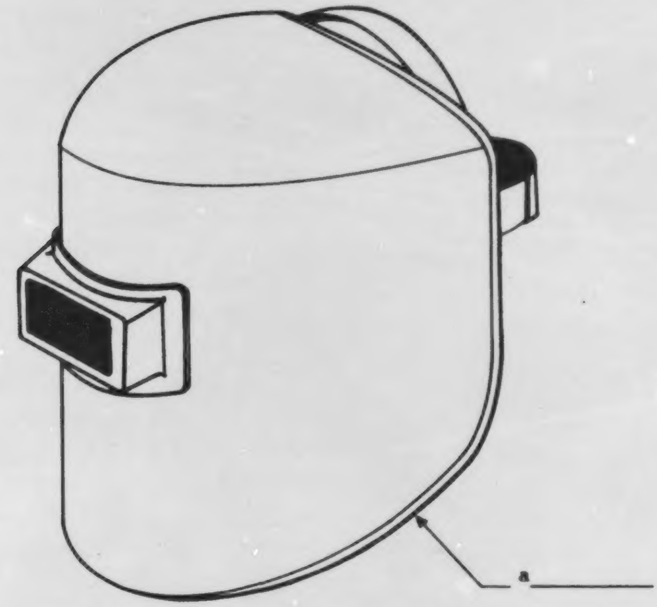
_____ K. Pliers

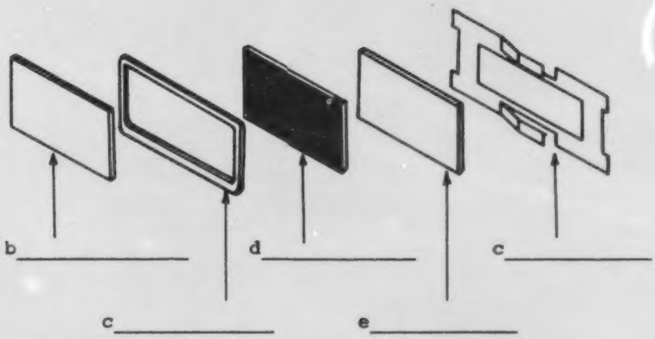
_____ L. Asbestos screen



7. Select the proper lens and sequence for installation in the welding helmet by placing each of the following in the appropriate blanks.

Hold-down clamp	Clear plastic lens
Helmet	Rubber gasket
Filter lens	Clear plastic lens





8. Select the proper safety procedures involving hazardous areas of arc welding by answering true or false to each of the statements below.

______ A. The welder does not need to be grounded to be safe.

______ B. The welder should be kept in a cool damp area.

______ C. Since the welding cables are armored, it does not hurt to run over them with the welding dolly.

______ D. When welding, do not stand on wet surfaces or in water.

______ E. Use electrode holders as long as possible, even when cracked, because they are expensive.

______ F. Wear leather gloves that are in good condition.

______ G. The face and eyes should be covered with an arc welding helmet or shield.

______ H. Ultraviolet and infrared rays will only burn the skin of certain people.

______ I. A verbal warning should be given to all persons in the area before striking an arc.

______ J. Cracks in a helmet will not be any problem if the lens are good.

______ K. Replace any cracked helmet lens.

______ L. Oxyacetylene goggles may be worn when arc welding.

______ M. Wear high-top shoes.

______ N. Low-top shoes may be worn if pants with cuffs are worn.

______ O. Shirts should have long sleeves and button-up collars.

______ P. Wear welding gloves of leather.

______ Q. Leather welding sleeves should be worn when available.

______ R. Leather aprons should be worn when available.

______ S. Safety glasses are not necessary if you shield your eyes with your hand when chipping or cleaning welds.

______ T. There is no danger when welding galvanized metal.

_____ U. Fans or adequate ventilation should be provided to remove toxic gases.

_____ V. Avoid welding on containers or metals that have contained chemicals or been painted.

_____ W. Sparks will not ignite oily rags.

_____ X. Do not weld on containers that have held a combustible substance.

_____ Y. Handle hot metal with leather gloves.

_____ Z. Stand to one side when dropping hot metal into a cooling vat because hot steam will then be given off.

_____ Aa. Molten metal splatter usually cools quickly and will not burn the skin.

9. Point out the types of arc welding electrodes by placing a "✓" in front of each of the following electrode types.

_____ A. Mild steel

_____ B. Low hydrogen

_____ C. High hydrogen

_____ D. Stainless steel

_____ E. Brass

_____ F. Cast iron

_____ G. Hard surfacing

_____ H. Copper

_____ I. Non-ferrous

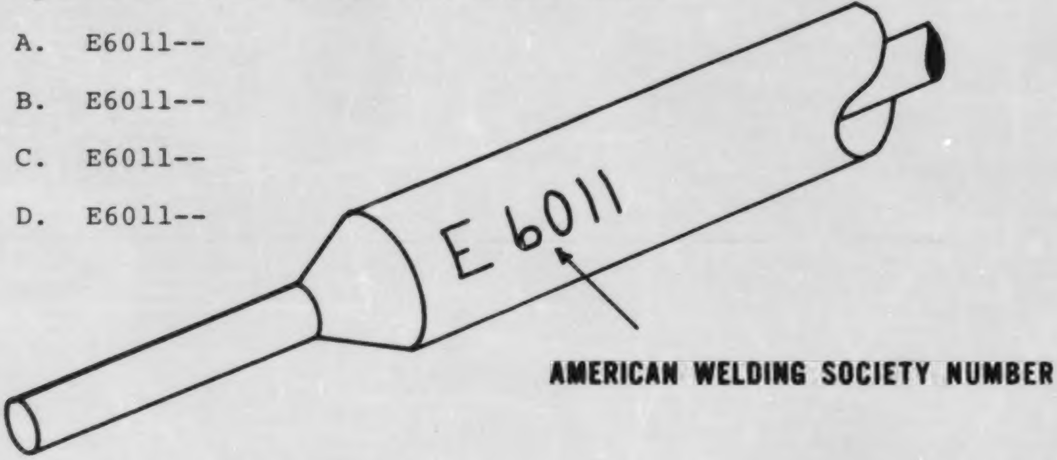
10. Explain the meaning of each of the American Welding Society specifications on the electrode below.

A. E6011--

B. E6011--

C. E6011--

D. E6011--


E 6011
AMERICAN WELDING SOCIETY NUMBER

11. Fill in the blank: Electrode size is determined by the _______ of metal core wire.

Length

Shape

Diameter

Color

12. Name the purposes of flux:

A.

B.

C.

D.

E.

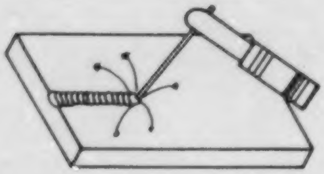
F.

G.

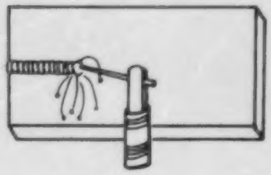
13. Identify each of the following positions by labeling each of the illustrations with one of the following:

Horizontal	Overhead
Vertical	Flat

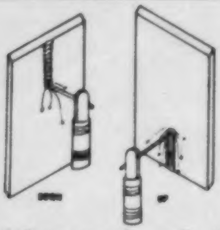
A. ____________________



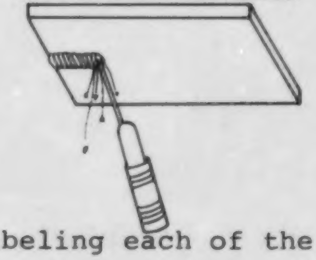
B. ____________________



C. ____________________



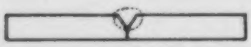
D. ____________________



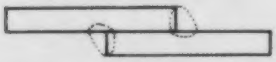
14. Identify each of the weld joints by labeling each of the illustrations with one of the following:

Edge joint	Butt joint
Tee joint	Lap joint

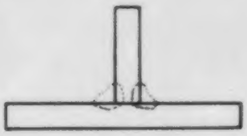
A.



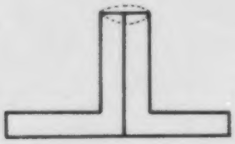
B.



C.



D.



15. Identify the weld types by filling in the correct answer in each blank from the list below.

__________ A. Weld deposited on unbroken surfaces to build-up worn parts

__________ B. Triangular cross-section weld used to join two pieces of metal at right angles of each other

__________ C. Weld made in a groove between two pieces of metal

__________ D. Weld used to join two overlapping pieces of metal through circular holes or slots

Plug and slot

Fillet

Groove

Surface

16. Identify each of the terms associated with the welding process by placing the number pointing to each of the parts to the left of the correct term.

_____ A. Weld

_____ B. Slag

_____ C. Base metal

_____ D. Angle of electrode

_____ E. Arc length

_____ F. Electrode

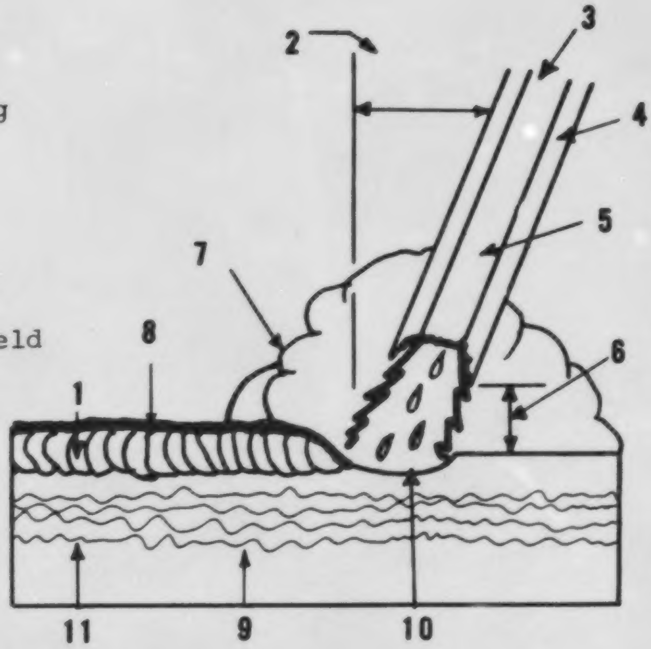
_____ G. Flux coating

_____ H. Wire core

_____ I. Crater

_____ J. Penetration

_____ K. Gaseous shield



WELDER'S HELPER

INFORMATION SHEET 15--INTRODUCTION TO MIG WELDING

I. Terms and defintions

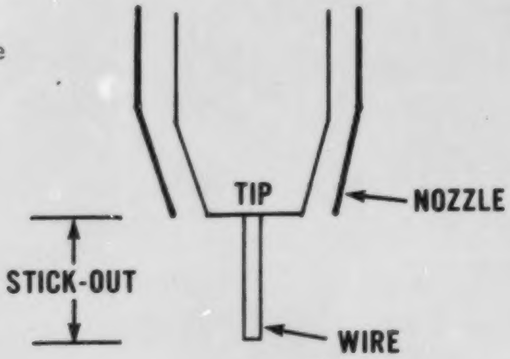
A. Gas Metal Arc Welding (GMAW)--A welding process using a consumable electrode which is fed to the weld joint and shielded with gas.

B. Metal Inert Gas Welding (MIG)--An abbreviation used to describe gas metal arc welding.

C. Short arc--A gas metal arc welding process using low voltage, low current and a small diameter wire.

D. Welding current (amperage)--Usually direct current reverse polarity, with the electrode (wire) positive and the work negative.

E. Stick-out--The distance the wire sticks out past the contact tip of the gun.



F. Whiskers--Short welding wires that feed through the weld and extend past the root of the weld.

G. Shielding gases--Gases used to replace the air around the arc to prevent oxidation and contamination.

II. Advantages of the MIG welding process.

A. Only a small amount of spatter and no slag are produced.

B. Faster welding rates are possible.

C. Different metal thicknesses may be welded without changing wire size.

D. Gaps and badly fitting joints may be filled easily without burning through.

E. Metal distortion is reduced.

F. Most alloys may be welded by choosing the correct filler wire and shielding gas.

G. Narrower beveled joint design may be used because of deep penetrating characteristics.

III. Types of MIG welding processes.

A. Short arc--Uses low current (amperage), low voltage and small wire size.

(NOTE: This is the most popular of the MIG welding processes.)

B. Spray arc--Employs high current (amperage), high voltage, and large wire size.

(NOTE: This process is used on thicker metals.)

C. Flux-cored wire--The flux generates a gas shield and a slag blanket that slows the cooling rate and protects the weld deposit as it solidifies.

(NOTE: Some wires of this type do not require shielding gases.)

IV. Factors to consider when selecting filler wire.

A. Alloy of metal to be welded.

B. Metal thickness.

C. Design of weld joint.

D. Job specifications.

V. Types of welding filler wire.

A. Solid

(NOTE: Solid wire is supplied in the following standard sizes: .035", .045", 1/16", 5/64", 3/32", and 1/8)

B. Flux-cored

(NOTE: Flux-cored wire is supplied in the following standard sizes: 1/16", 5/64", 3/32", 7/64", 1/8", and 5/32".)

VI. Shielding gas types

A. Argon

B. Helium

C. CO2--Carbon dioxide

(NOTE: Shielding gases may be mixed in different amounts, depending on the alloy of the metal being welded.)

VII. Factors to consider when adjusting flow rate of shielding gases

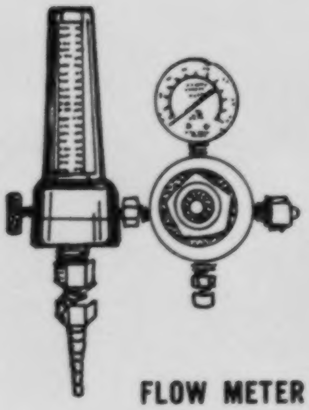
(NOTE: Shielding gases are supplied in steel cylinders similar to other types of gases.)

A. The amount of shielding gas supplied at the weld is controlled by a gas flow meter.

B. The flow rate is measured in cubic feet per hour, (CFH).

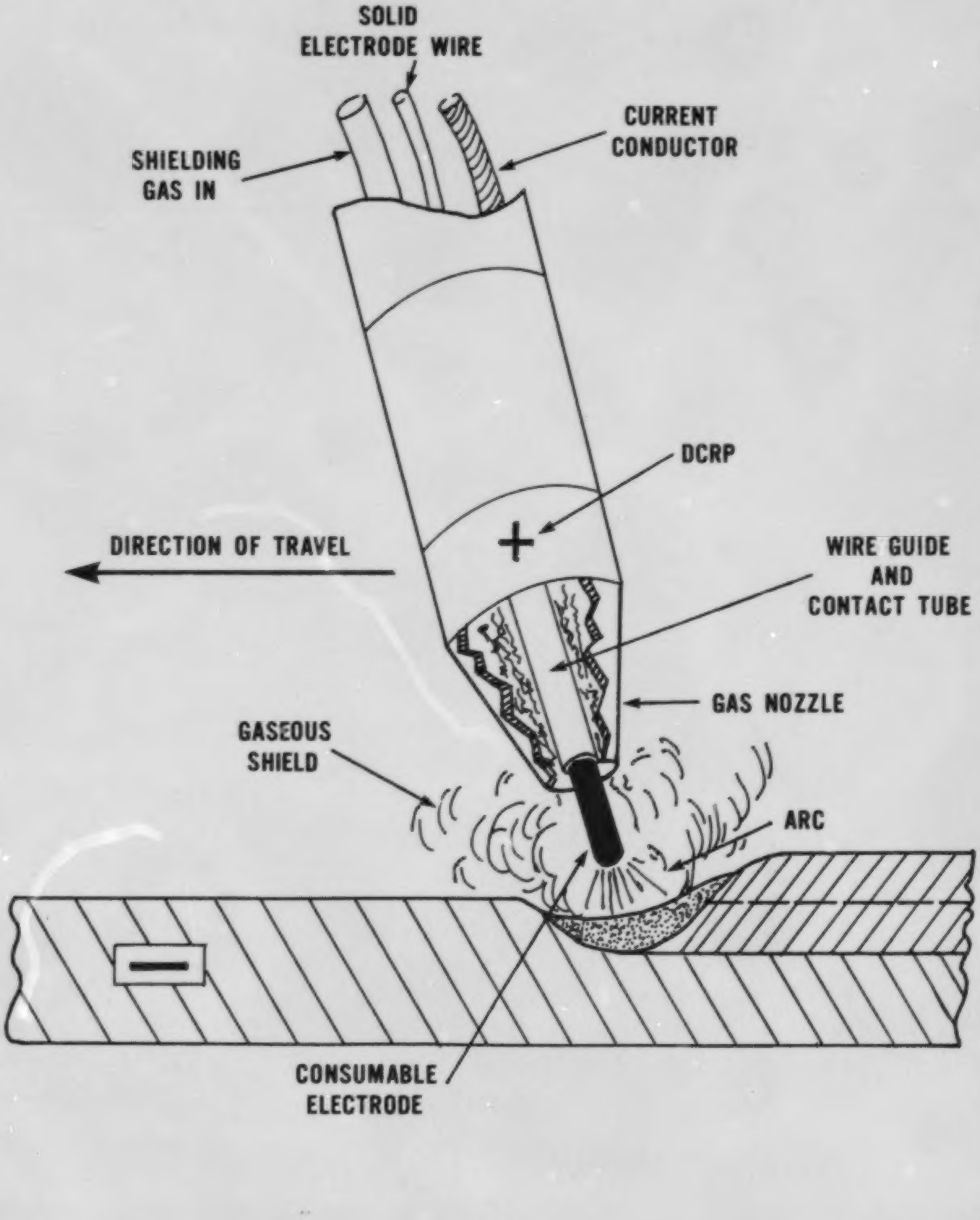
C. The flow meter is adjusted to provide the proper amount of shielding gas for the thickness of metal being welded.

(NOTE: Refer to TM-3 for proper flow rate.)



FLOW METER

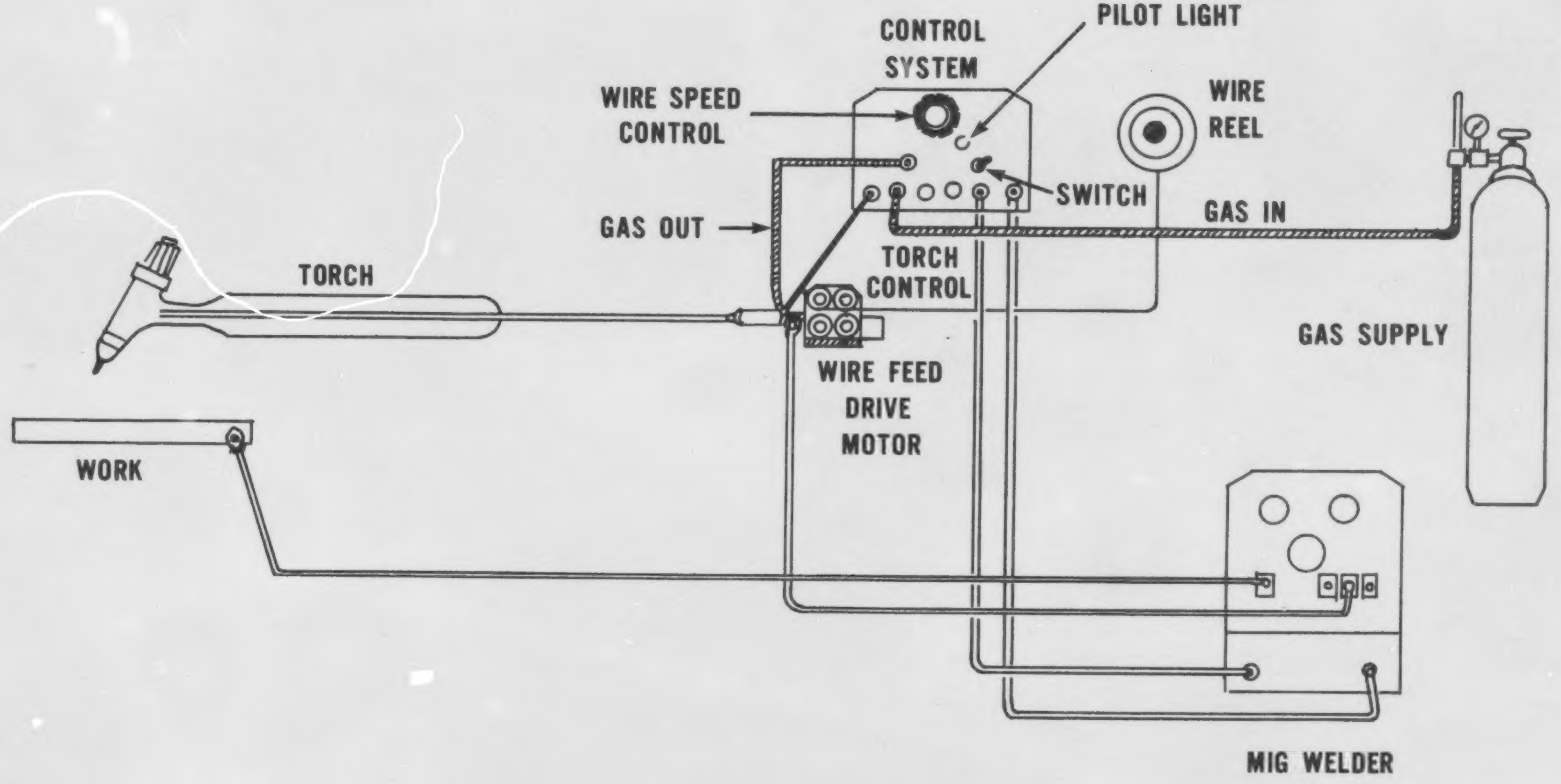
MIG WELDING PROCESS


SOLID
ELECTRODE WIRE
SHIELDING
GAS IN
CURRENT
CONDUCTOR
DCRP
+
DIRECTION OF TRAVEL
WIRE GUIDE
AND
CONTACT TUBE
GAS NOZZLE
GASEOUS
SHIELD
ARC
—
CONSUMABLE
ELECTRODE

MIG SET-UP CHART

ALL JOINTS ALL POSITIONS MILD STEEL							
MATERIAL THICKNESS		NUMBER OF PASSES	WIRE DIAMETER	WELDING CONDITIONS DCRP		GAS FLOW CFH	TRAVEL SPEED IPM
GAGE	INCH			ARC VOLTS	AMPERES		
24	.023	1	.030	15-17	30-50	15-20	15-20
22	.029	1	.030	15-17	40-60	15-20	18-22
20	.035	1	.035	15-17	65-85	15-20	35-40
18	.047	1	.035	17-19	80-100	15-20	35-40
16	.059	1	.035	17-19	90-110	20-25	30-35
14	.074	1	.035	18-20	110-130	20-25	25-30
12	.104	1	.035	19-21	115-135	20-25	20-25
11	.119	1	.035	19-22	120-140	20-25	20-25
10	.134	1	.045	19-23	140-180	20-25	27-32
	3/16 in	1	.045	19-23	180-200	20-25	18-22
	1/4 in	1	.045	20-23	180-200	20-25	12-18

MIG WELDING OUTFIT


CONTROL SYSTEM
PILOT LIGHT
WIRE SPEED CONTROL
WIRE REEL
SWITCH
GAS IN
GAS OUT
TORCH
TORCH CONTROL
GAS SUPPLY
WIRE FEED DRIVE MOTOR
WORK
MIG WELDER

ASSIGNMENT SHEET 15-INTRODUCTION TO MIG WELDING

I. Write the definitions for the following:

   A. Shielding gases--

   B. Welding current--

   C. MIG--

   D. Stick-out--

II. List four advantages of the MIG welding process.

   A.

   B.

   C.

   D.

III. Identify the three types of MIG welding processed by filling in the correct term in each blank from the list below.

Short arc   Flux-colored wire   Spray arc

__________ A. Uses low current (amperage), low voltage, and small size wire.

__________ B Employs high current (amperage), high voltage, and large size wire.

__________ C. The flux generates a gas shield and a slag blanket that slows the cooling rate and protects the weld deposit as it solidifies.

IV. List four factors to consider when selecting MIG welding wire.

A.

B.

C.

D.

V. Fill in the blanks: The two types of MIG filler wire are ________________ and ________________.

VI. List three types of shielding gases used for MIG welding:

A.

B.

C.

VII. Identify three factors to consider when adjusting flow rate of shielding gases.

A.

B.

C.

WELDER'S HELPER

TEST PART 4

1. Match the following terms and definitions

1. Shielding gases	_____	A.	Gases used to displace the air around the arc to prevent oxidation and contamination
2. Whiskers	_____	B.	A welding process using a consumable electrode which is fed to the weld joint and shielded with gas
3. Stickout	_____	C.	An abbreviation used to describe gas metal arc welding
4. Welding current	_____	D.	A gas metal arc welding process using low voltage, low current, and small wire diameter
5. Short arc	_____	E.	Usually direct current reverse polarity with the electrode (wire) positive and the work negative
6. MIG welding	_____	F.	The distance the wire sticks out past the contact tip of the gun
7. Gas metal arc welding	_____	G.	Short welding wires that feed through the weld and extend past the root of the weld

2. Point out the advantages of MIG welding by placing a "✓" in the space provided at the left.

_____ A. A small amount of spatter and no slag

_____ B. Low welding rate

_____ C. Different metal thicknesses may be welded without changing wire size

_____ D. Gaps and badly fitting joints may be filled easily without burning through

_____ E. Metal distortion is reduced

_____ F. Narrower beveled joint design can be used

3. Point out the types of MIG welding processes by placing a "✓" in the space provided at the left

    _____ A. Short arc--Uses low current (amperage), low voltage and small wire size

    _____ B. Spray arc--Employs high current (amperage), high voltage and large wire size

    _____ C. Flux-cored wire--Can be used without a shielding gas to weld steel

4. Point out the factors to consider when selecting filler wire by placing a "✓" in the space provided at the left

    _____ A. Alloy of metal to be welded

    _____ B. Amount of rust on the metal

    _____ C. Metal thickness

    _____ D. Design of weld joint

    _____ E. Job specifications

5. Identify the types of welding filler wire by placing a "✓" in the space provided at the left

    _____ A. Solid

    _____ B. Flux-cored

    _____ C. Flux-coated

6. Identify the types of shielding gases by placing a "✓" in the space provided at the left

    _____ A. Argon

    _____ B. Oxygen

    _____ C. Acetylene

    _____ D. Helium

    _____ E. Carbon dioxide

7. Point out the factors to consider when adjusting shielding gas flow rate by placing a "✓" in the space provided at the left

    _____ A. The amount of shielding gas supplied at the weld is controlled by a gas flow meter

    _____ B. Too much shielding gas will change the color of the metal being welded

_____ C. The flow rate is measured in cubic feet per hour

_____ D. The flow meter is adjusted to provide the proper amount of shielding gas for the thickness of metal being welded

_____ E. Too little shielding gas will cause the weld to be of high quality

INFORMATION SHEET 16-INTRODUCTION

I. Terms and definitions

A. Aluminum Oxide--A thin coating on aluminum that is caused by oxygen mixing with the surface of the metal.

B. Conductivity--The ability of a metal to transfer heat or electricity quickly.

C. Gas Tungsten Arc Welding (GTAW)--An arc welding process using a non-consumable electrode to produce an arc shielded by a gas.

(NOTE: Most commonly used on non-ferrous metals such as aluminum, copper, and stainless steel).

D. High-frequency current--A high voltage alternating current that is used in welding aluminum because this current removes oxides and allows arcs to be started quicker.

E. Inert gas--A gas used to keep oxygen, nitrogen, or impurities out of the weld area.

F. Porous--A term used to describe a weld with air pockets or bubbles in the weld metal.

G. Tungsten Inert Gas Welding (TIG)--A term often used in place of gas tungsten arc welding.

(NOTE: Also referred to as Heliarc Welding.)

II. Advantages of the TIG welding process

A. Very little spatter and slag are produced.

B. No flux is required.

C. Little cleaning is required after the weld is made.

(NOTE: Air is kept away from the molten metal by the inert shielding gas).

D. The weld is usually stronger than the metal being welded because it is kept pure by the shielding gas.

E. Welding can easily be done in all positions.

(NOTE: This is because there is no flux or slag).

F. The weld area can easily be seen.

G. The metal does not warp because the weld heat is directed to a small area.

H. Most metals and alloys of various thicknesses can be welded.

  1. Aluminum
  2. Magnesium
  3. Stainless steel
  4. Nickel
  5. Copper
  6. Brass
  7. Carbon and low alloy steel

III. The welding process

A. Tungsten--Identifies the metal in the non-consumable electrode which carries current to produce the arc.

B. Inert--Identifies the gas that is used to shield the weld area because it will not combine with air or other materials.

C. Gas--Identifies the shield or material around the weld that keeps out air or other matter.

D. Shielded--Describes the process of removing the air or other matter from the weld area.

E. Arc--Identifies the type of welding being done.

ASSIGNMENT SHEET 16-INTRODUCTION

I. Write the definitions for the following:

A. Inert gas--

B. Arc--

C. TIG--

D. Shielded--

E. Gas Tungsten Arc Welding (GTAW)--

F. Tungsten--

G. Aluminum Oxide--

II. List four advantages of the TIG welding process:

A.

B.

C.

D.

III. Name four common metals which can be TIG welded.

A.

B.

C.

D.

INFORMATION SHEET 17-EQUIPMENT

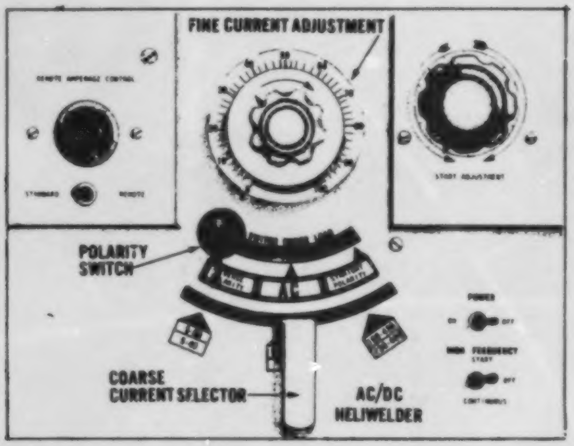
I. The TIG welding machine

A. Supplies AC and DC current.

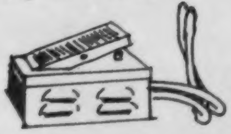
(NOTE: A switch is provided on most machines for easy selection.)

B. Has coarse current range selectors.

1. Machine mounted


FINE CURRENT ADJUSTMENT
REMOTE AMPERAGE CONTROL
STANDARD
REMOTE
START ADJUSTMENT
POLARITY SWITCH
AC
POWER
ON
OFF
HIGH FREQUENCY START
OFF
CONTINUOUS
COARSE CURRENT SELECTOR
AC/DC HELIWELDER

2. Remote controlled (foot-operated)



C. Has fine current range controls

(NOTE: The fine current range control regulates the high frequency current which is necessary to get an arc to jump the gap between the electrode and metal without touching the two together.)

D. Is equipped with a solenoid switch

1. Controls the flow of gas

2. Controls the flow of water

E. Has an after flow timer

1. Controls the length of time the gas flows through the cup after the arc is stopped.

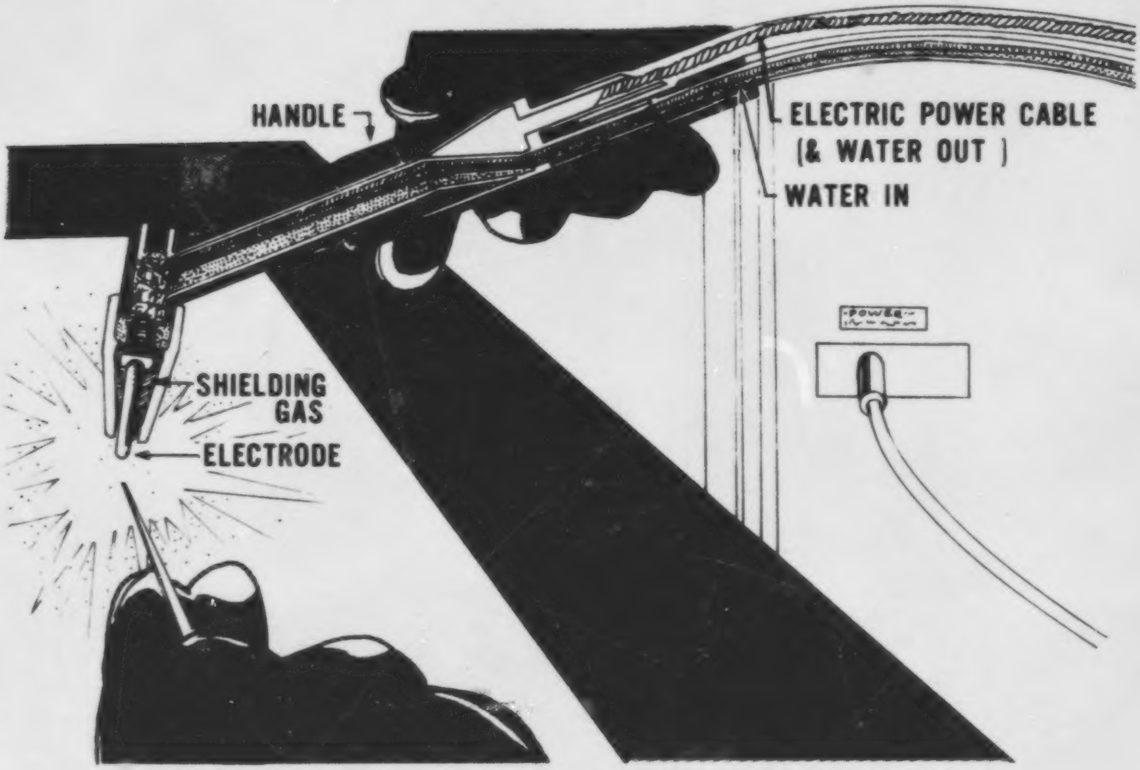
2. Controls the length of time the water flows through the torch after the arc is stopped.

II. The torch

(NOTE: Some torches are air-cooled.)

A. Has several purposes

1. Provides a handle
2. Holds the electrode
3. Carries gas to the arc
4. Carries electricity to the arc
5. Carries water to cool the torch head


HANDLE
ELECTRIC POWER CABLE (& WATER OUT)
WATER IN
SHIELDING GAS
ELECTRODE
POWER

1. Torch body--Holds all other parts together.
2. Collet holder--Holds collet in place.
3. Collet--Holds electrode.
4. Electrode--Made of tungsten.

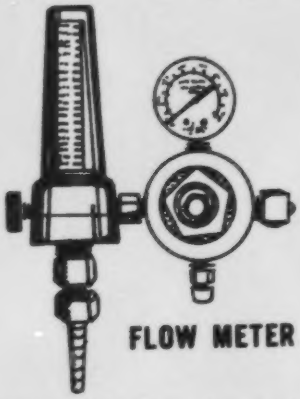
   (NOTE: Electrodes come in various diameters and lengths.)
5. Cap--Tightens collet on electrodes.

6. Cup (or nozzle)--Directs shielding gas around electrode and to the weld area.

III. The flowmeter (regulator)

A. Regulates flow of gas in cubic feet per hour (CFH).

B. Indicates pressure in the gas cylinder in pounds per square inch (PSI).



FLOW METER

C. Must be in an upright postion.

D. Has a flow scale for each type of gas.

   1. Argon

   2. Helium

   3. Carbon dioxide

E. Reduces the high pressure of the cylinder to a lower working pressure.

IV. Cylinders

A. Can contain three different gases

   1. Argon--An inert gas that is the best for shielding the weld area because it is heavier.

   2. Helium--A very light gas that will quickly float away from the weld area.

   3. Carbon dioxide--The poorest of the three shielding gases.

B. Contains 330 cubic feet at 3000 pounds per inch (PSI).

V. Electrodes

A. Are made of tungsten

(NOTE: They are considered to be non-consumable because the melting point of tungsten is very high (6,900) and will not wear away rapidly).

B. Come in different lengths and diameters

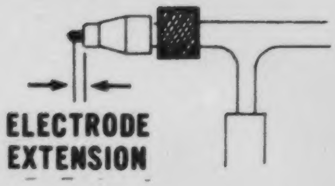
   1. Lengths--3", 6", 7", 18", and 24".

   2. Diameters--.010", .020", .040", 1/16", 3/32", 1/8", 5/32", 3/16", and 1/4".

C. Are very expensive and should be prepared carefully.

D. Must be adjusted for extension past the cup.

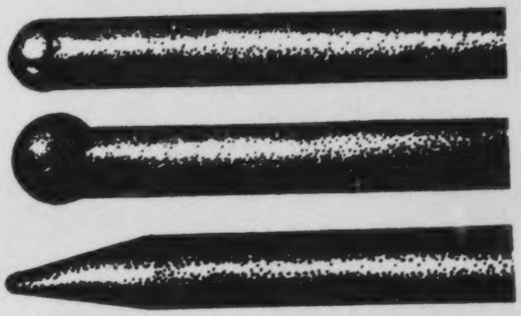
(NOTE: This is called the stick out and is usually 1½ the diameter of the electrode).



E. 1. Rounded end used for direct current reverse polarity (DCRP).

2. Balled end used for alternating current (AC).

3. Pointed end used for direct current straight polarity (DCSP).



VI. Cups or nozzles

A. Come in several types

1. Ceramic--Most commonly used with air-cooled torches up to 250-300 amps. flow. Above this level, water-cooled metal cups are needed.

2. Metal--Usually made of copper and chrome-plated to reflect heat radiation and to prevent accumulations of weld splatter. Used with water-cooled torches.

3. Pyrex glass--Made of clear glass.

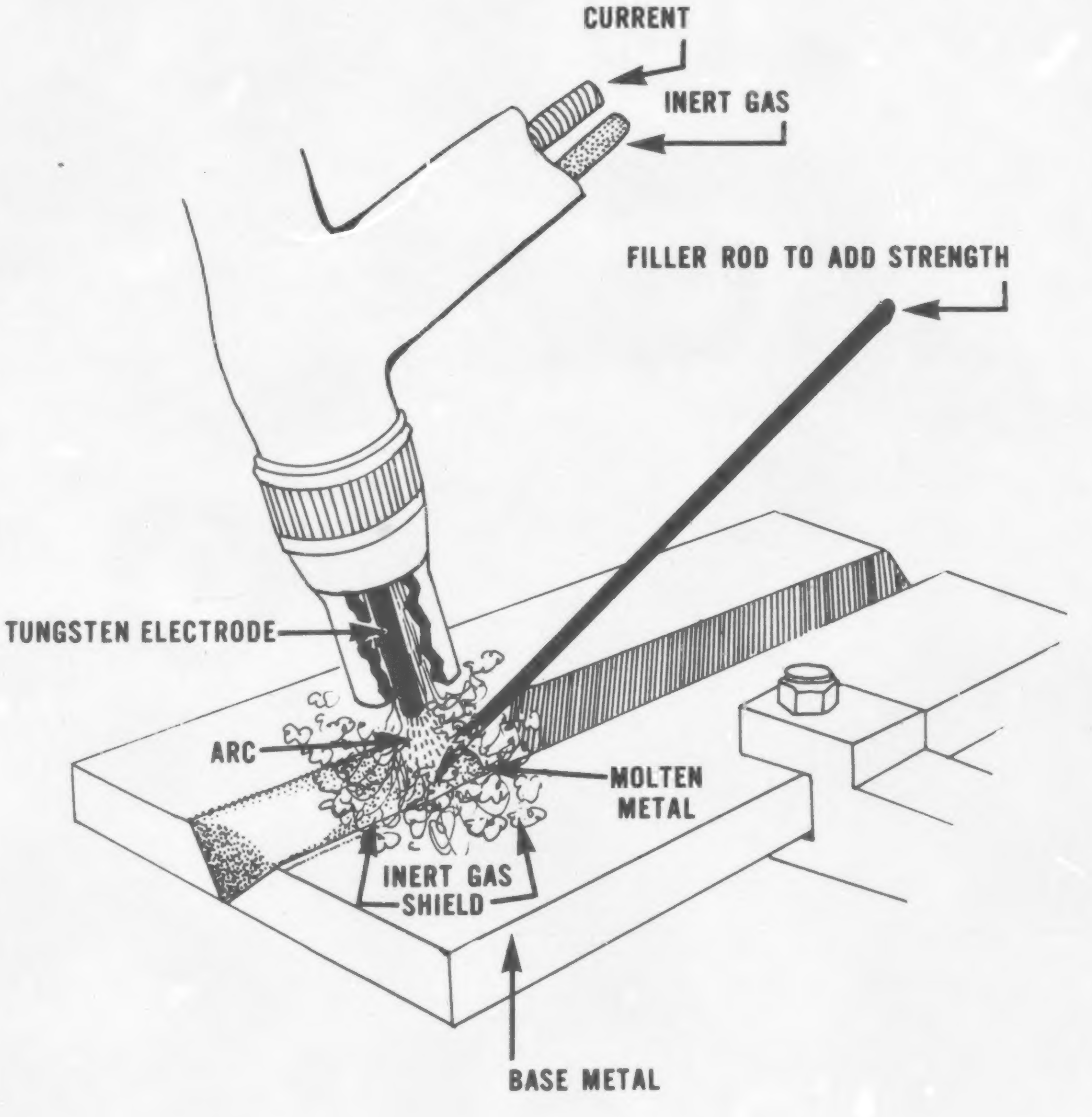
CAUTION: Ceramic and pyrex glass cups are easily broken.

B. Are available in many sizes

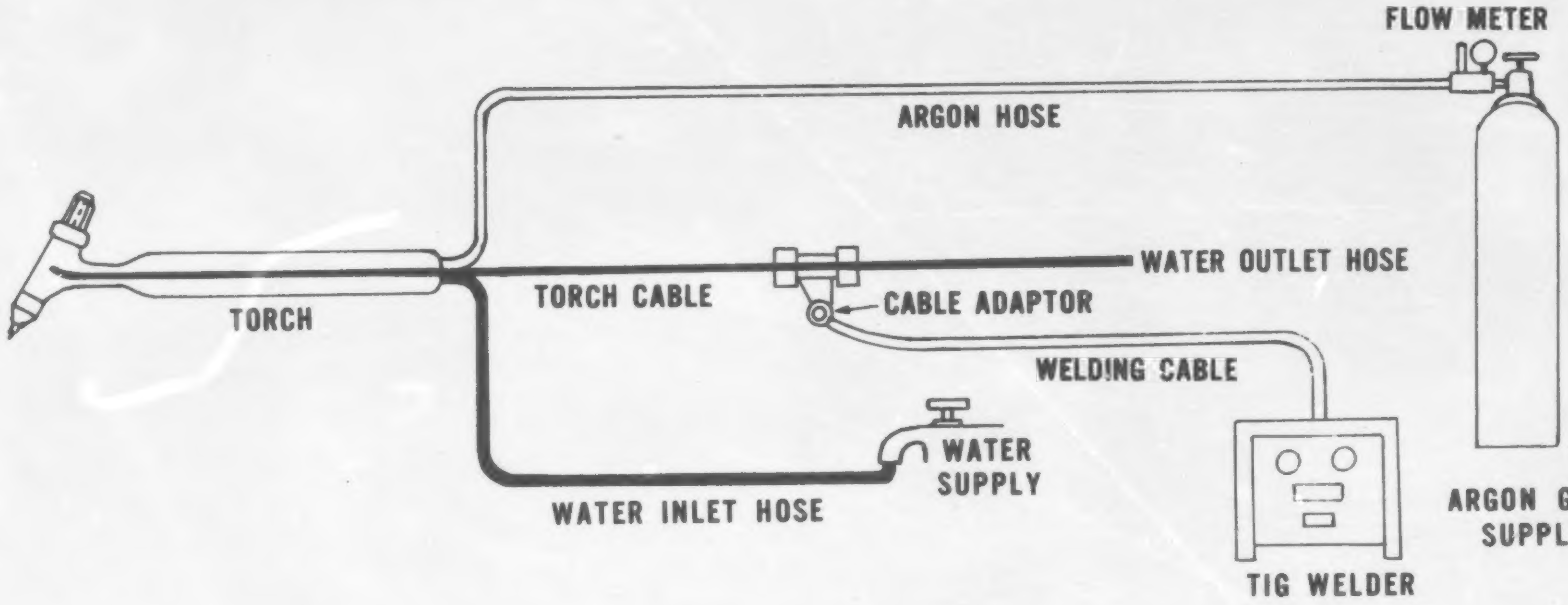
(NOTE: The size to be used depends upon the type and size of torch and the diameter of the electrode. It is a good practice to follow the manufacturer's recommendations. The number of the cup indicates the inside diameter of the cup opening).

EXAMPLE: A #8 cup size means that the opening diameter is 8/16 inch or 1/2 inch.

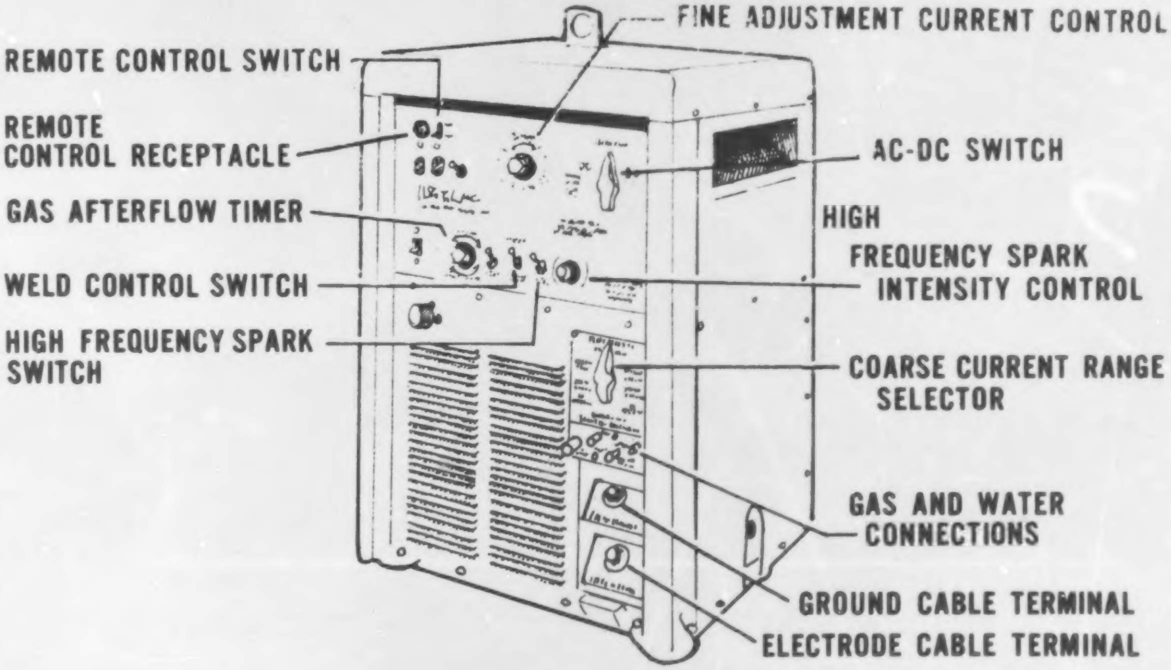
TUNGSTEN INERT-GAS SHIELDED-ARC WELDING

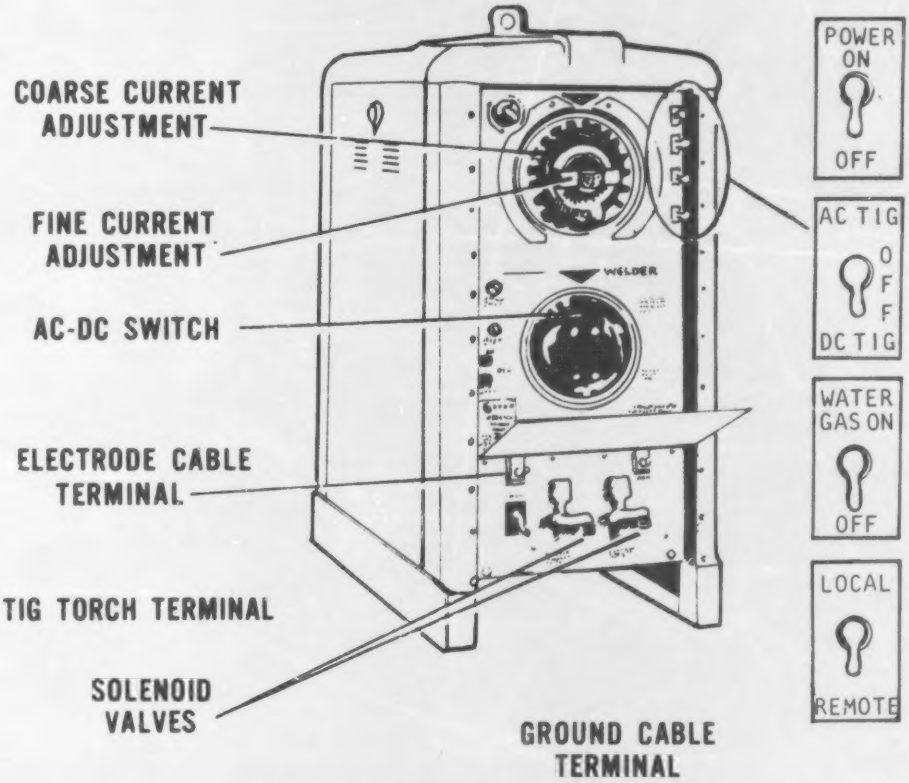

CURRENT
INERT GAS
FILLER ROD TO ADD STRENGTH
TUNGSTEN ELECTRODE
ARC
MOLTEN METAL
INERT GAS SHIELD
BASE METAL

PARTS OF A WATER-COOLED TIG WELDING UNIT

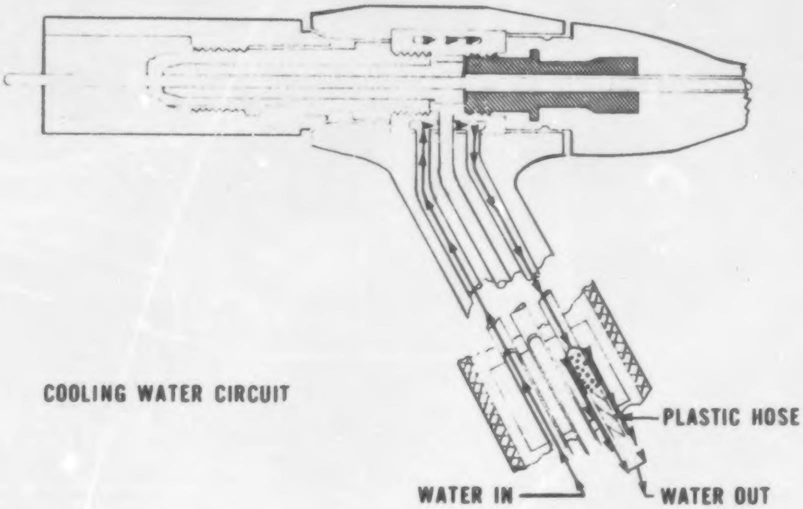

FLOW METER
ARGON HOSE
TORCH
TORCH CABLE
WATER OUTLET HOSE
CABLE ADAPTOR
WELDING CABLE
WATER SUPPLY
WATER INLET HOSE
ARGON GAS SUPPLY
TIG WELDER

TYPES OF WELDER CONTROLS

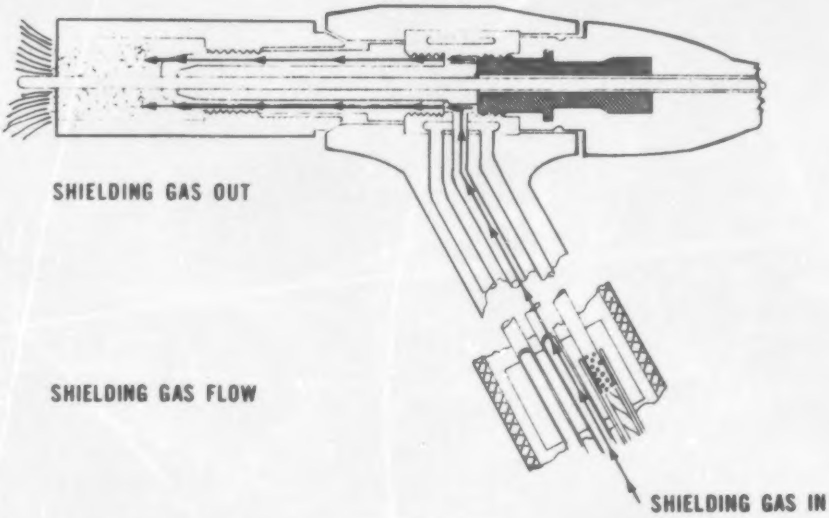

FINE ADJUSTMENT CURRENT CONTROL
REMOTE CONTROL SWITCH
REMOTE CONTROL RECEPTACLE
AC-DC SWITCH
GAS AFTERFLOW TIMER
HIGH FREQUENCY SPARK INTENSITY CONTROL
WELD CONTROL SWITCH
HIGH FREQUENCY SPARK SWITCH
COARSE CURRENT RANGE SELECTOR
GAS AND WATER CONNECTIONS
GROUND CABLE TERMINAL
ELECTRODE CABLE TERMINAL


COARSE CURRENT ADJUSTMENT
FINE CURRENT ADJUSTMENT
AC-DC SWITCH
ELECTRODE CABLE TERMINAL
TIG TORCH TERMINAL
SOLENOID VALVES
GROUND CABLE TERMINAL
WELDER
POWER ON
OFF
AC TIG
OFF
DC TIG
WATER GAS ON
OFF
LOCAL
REMOTE

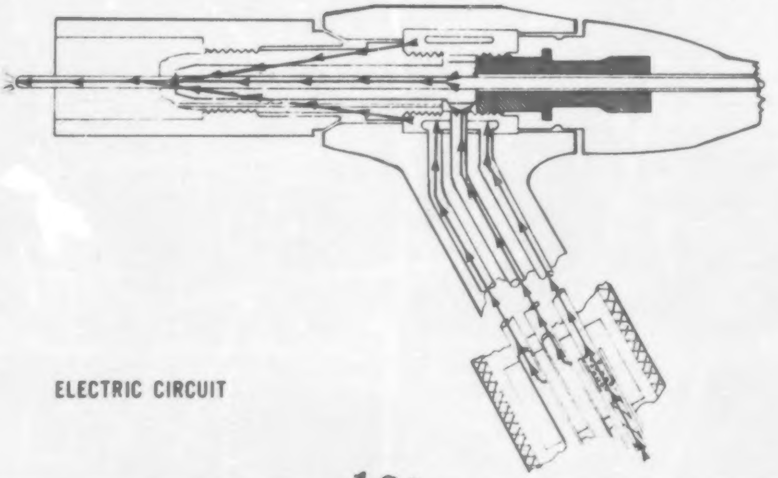
THE PATH OF WATER, GAS, AND CURRENT IN THE TORCH


PLASTIC HOSE
WATER IN
WATER OUT

COOLING WATER CIRCUIT

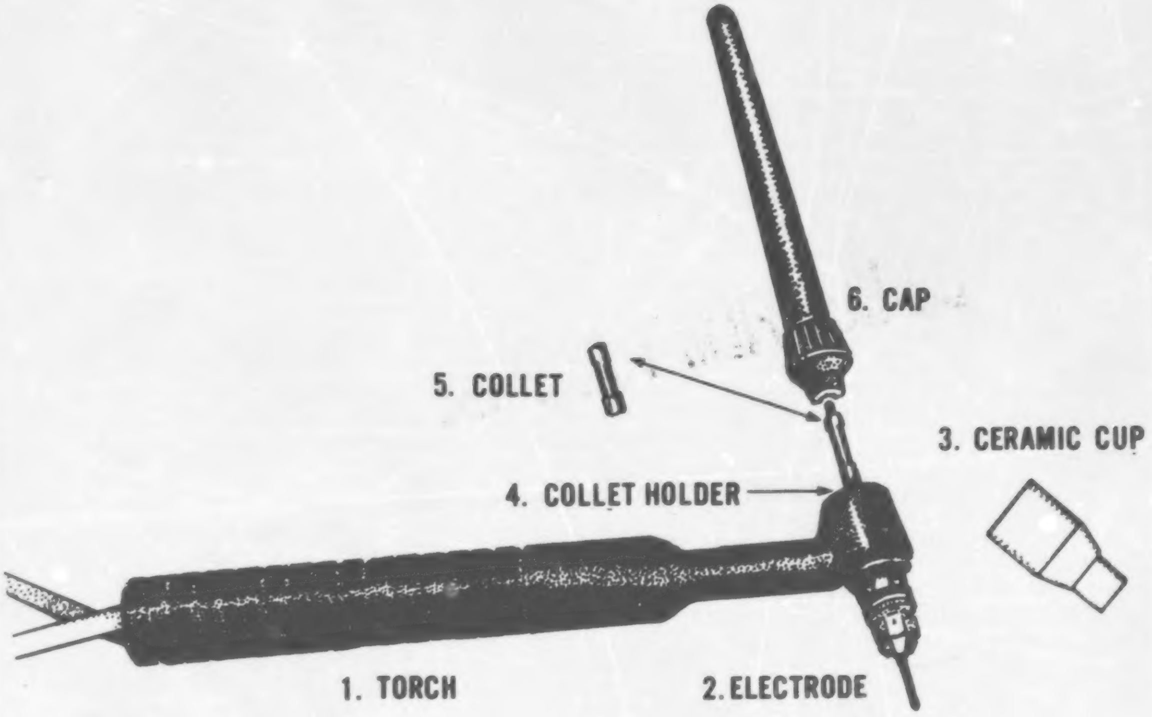

SHIELDING GAS OUT
SHIELDING GAS IN

SHIELDING GAS FLOW



ELECTRIC CIRCUIT

PARTS OF A TORCH ASSEMBLY


6. CAP
5. COLLET
3. CERAMIC CUP
4. COLLET HOLDER
1. TORCH
2. ELECTRODE

TIG WELDING DATA FOR ALUMINUM IN THE FLAT POSITION

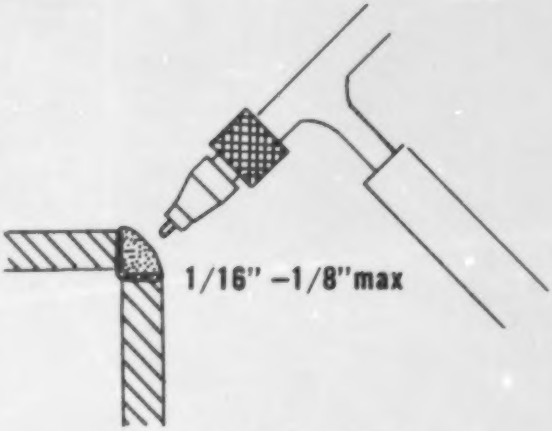
Metal Thickness in Inches	Welding Current Flat* Amperes	Tungsten Electrode Diameter	Welding Speed Inches per Minute	Filler Rod Diameter	Recommended Argon Flow Cubic Feet per Hour	Gas Nozzle or Cup Size
1/16	60-80	1/16	12	1/16	15 to 20	4,5,6
1/8	125-145	3/32	12	3/32 or 1/8	17 to 25	6,7
3/16	190-220	1/8	11	1/8	21 to 30	7,8
1/4	260-300**	3/16	10	1/8 or 3/16	25 to 35	8, 10
3/8	330-380**	3/16, 1/4	5	3/16 or 1/4	29 to 40	10
1/2	400-450**	3/16, 1/4	3	3/16 or 1/4	31 to 40	10

TIG WELDING DATA FOR STAINLESS STEEL IN THE FLAT POSITION

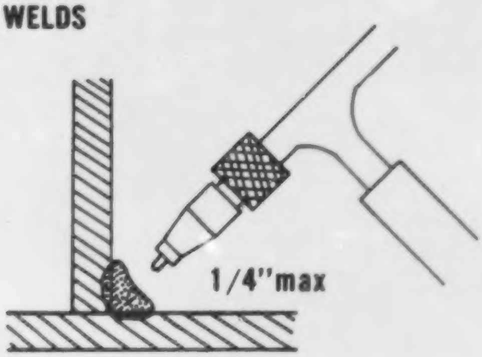
Thickness in Inches	Type of Weld	D.C.S.P. Welding Current Flat Amperes	Tungsten Electrode	Welding Speed Inches per Minute	Filler Rod Diameter	Recommended Argon Flow Cubic Feet per Hour
1/16	Butt	80-100	1/16	12	1/16	11
	Lap	100-120	1/16	10	1/16	11
	Corner	80-100	1/16	12	1/16	11
	Fillet	90-100	1/16	10	1/16	11
3/32	Butt	100-120	1/16	12	3/32	11
	Lap	110-130	1/16	10	3/32	11
	Corner	100-120	1/16	12	3/32	11
	Fillet	110-130	1/16	10	3/32	11
1/8	Butt	120-140	1/16	12	3/32	11
	Lap	130-150	1/16	10	3/32	11
	Corner	120-140	1/16	12	3/32	11
	Fillet	130-150	1/16	10	3/32	11
3/16	Butt	200-250	3/32	10	1/8	13
	Lap	225-275	1/8	8	1/8	13
	Corner	200-250	3/32	10	1/8	13
	Fillet	225-275	1/8	8	1/8	13
1/4	Butt	275-350	1/8	5	3/16	13
	Lap	300-375	1/8	5	3/16	13
	Corner	275-350	1/8	5	3/16	13
	Fillet	300-375	1/8	5	3/16	13
1/2	Butt	350-450	3/16	3	1/4	15
	Lap	375-475	3/16	3	1/4	15
	Corner	375-475	3/16	3	1/4	15

ELECTRODE STICKOUT

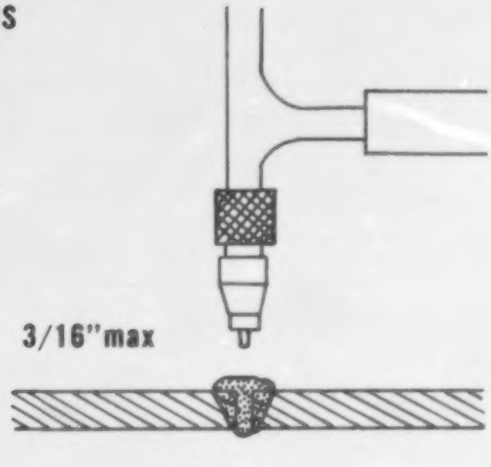
(1 1/2 THE DIAMETER OF THE ELECTRODE)



FOR CORNER WELDS



FOR FILLET WELDS



FOR BUTT WELDS

ASSIGNMENT SHEET 17-EQUIPMENT

I. Fill in the blanks in the following:

A. The TIG welding machine welds with _______ and ________ current.

B. The coarse current (amperage) selector can be __________ mounted or ___________ controlled.

C. The ___________ current (amperage) regulates the high frequency current.

D. The ___________ switch controls the flow of gas and water.

E. The length of time that the gas and water flow to the torch after the arc is stopped is controlled by the ______ timer.

II. The torch in the TIG welding process has several purposes, list them.

A.

B.

C.

D.

E.

III. Explain the function of each of the following parts on the TIG torch.

A. Torch body--

B. Collet holder--

C. Collet--

D. Cap

E. Cup

IV. In TIG welding, the flowmeter (regulator) is very important. Why?

V. The shielding gases (argon, helium, CO_2) are distributed in standard cylinders containing ________ cubic feet at _____ PSI

VI. A. Why are tungsten electrodes used in TIG welding considered nonconsumable?

B. Tungsten electrodes come in many different lengths and diameters. List three lengths and four diameters.

Length	Diameter
1.	1.
2.	2.
3.	3.
	4.

VII. Draw the shape of the tungsten electrode ends for the following types of current.

A. AC--

B. DCSP--

C. DCRP--

VIII. A. Explain when to use the ceramic and metal cups or nozzles.

B. Fill in the blanks: The size of of cup or nozzles to be used depends upon the __________ and __________ of the torch and the __________ of the electrode.

TEST--PART 5

1. Match the terms and definitions associated with TIG welding by writing the number of each term on the right in the correct blank on the left.

_____ a. A high-voltage alternating current that is used in welding aluminum.

_____ b. The ability of a metal to transfer heat or electricity quickly.

_____ c. A gas used to keep oxygen, nitrogen, or impurities out of the weld area.

_____ d. A term used to describe a weld with air pockets or bubbles in the weld metal.

_____ e. A thin coating on aluminum that is caused by oxygen mixing with the surface of the weld.

_____ f. An arc welding process using a non-consumable electrode to produce an arc shield by a gas.

_____ g. A term often used in place of gas tungsten arc welding.

1. Aluminum oxide
2. Conductivity
3. Gas tungsten arc welding
4. High frequency current
5. Inert gas
6. Porous
7. Tungsten Inert Gas welding (TIG)

2. Point out the advantages of the TIG welding process by placing a "✓" in front of each correct statement below.

_____ a. The process is a very cheap process.

_____ b. The welding speed is faster than regular stick-arc welding.

_____ c. Very little spatter or slag are formed.

_____ d. No flux is required.

_____ e. Little cleaning is required.

_____ f. The weld is usually stronger than the weld metal.

_____ g. Welding can easily be done in all positions.

_____ h. The welder does not have to watch the welding process.

_____ i. The weld can easily be seen.

_____ j. The metal does not warp as much as with regular stick-arc welding.

_____ k. Most metals and their alloys can be welded.

3. Identify the parts of the welding process by circling the word that best completes each statement below.

   a. (Aluminum, Tungsten) is the metal in the non-consummable electrode used in TIG welding.

   b. The type of gas most often used in the TIG process is an (inert, active) gas which does not combine with air.

   c. The shield around the weld area is produced by the (flux, gas).

   d. The (shielding, chemical) process of the gas removes air and impurities from the weld area.

   e. The TIG process is described as a (gas, arc) welding process.

WELDER'S HELPER

1. Identify the functions of the TIG welder by selecting the phrase that best completes each statement below. Write the correct number in the space provided.

_____ a. The current selection switch allows the welder to select from

1. DC straight or reverse only
2. AC or DC.
3. AC positive or negative

_____ b. Current range selectors are

1. machine mounted or remote control
2. all automatic
3. all remote controlled

_____ c. The current is adjusted for the welder's satisfaction with the

1. "OFF" "ON" switch
2. flowmeter
3. five current control

_____ d. A solenoid switch controls the flow of

1. gas and water
2. electricity to the electrode
3. the buildup of the weld

_____ e. The length of time that the gas and water flow to the torch after the arc is stopped is controlled by the

1. afterflow timer
2. flowmeter
3. remote control

2. Identify the parts of the torch by writing the number of each part in the blank by the correct name.

_____ a. Torch body

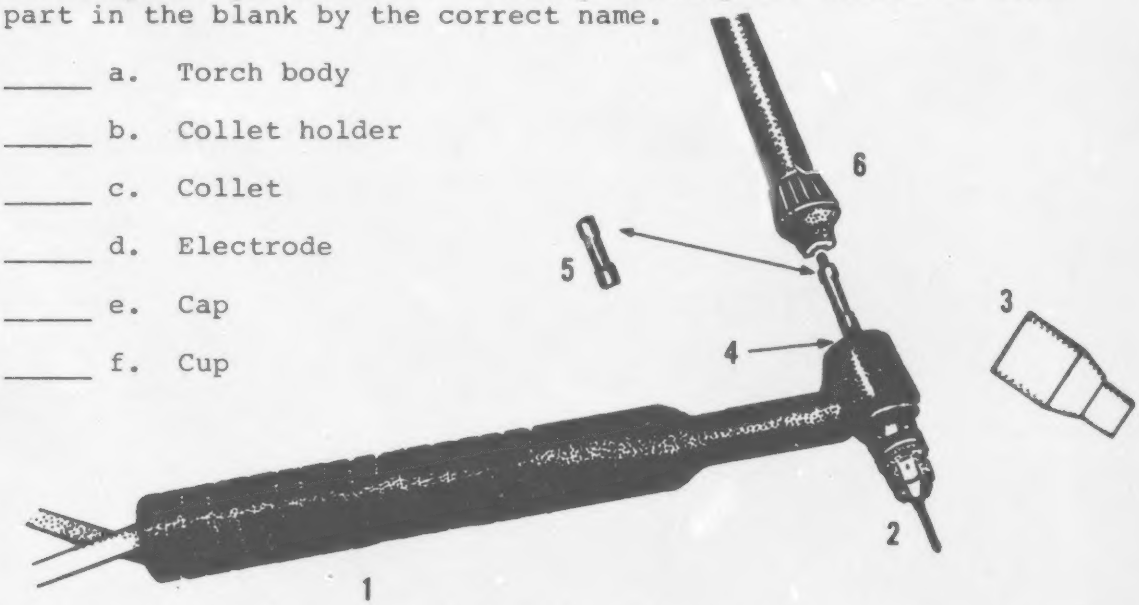
_____ b. Collet holder

_____ c. Collet

_____ d. Electrode

_____ e. Cap

_____ f. Cup



3. Point out the use of the flow meter by circling the word or words that best complete each statement below.

   a. The flowmeter regulates the flow of gas in cubic feet per (minute, hour).

   b. The flowmeter indicates the pressure in the gas cylinder in (pounds per square inch, gallons).

   c. The flowmeter must be mounted in a (horizontal, upright) position.

   d. The flow scale shows the flow of argon, helium, and (nitrogen, carbon dioxide).

   e. The flow meter (expands, reduces) the high pressure of the cylinder to a working pressure.

4. Point out the contents of the gas cylinders used in TIG welding by answering each question below with the correct answer from the list below.

   Argon
   Helium
   Nitrogen
   Carbon dioxide
   Oxygen
   330 cubic feet
   220 cubic feet
   Acetylene
   50 gallons

   a. The inert gas that is best suited for shielding the weld area because it is heavier is? ________________________

   b. The poorest of the three shielding gases is? _______________

   c. The large gas cylinder used in TIG welding contains? ________

   d. The gas used in TIG welding which is very light is? ________

5. Identify the factors that are considered when selecting electrodes for TIG welding by placing a "√" in front of the phrase that best completes each statement below.

   a. Tungsten electrodes are considered to be

      _____ 1. inexpensive

      _____ 2. non-consumable

      _____ 3. soft

   b. Electrodes come in lengths of:

      _____ 1. 12-16 feet

      _____ 2. 3-24 inches

      _____ 3. 1-2 inches

   c. Electrodes come in diameters between:

      _____ 1. 1/16 and 1/4 inch

      _____ 2. 1/2 and 3/4 inch

      _____ 3. 1 and 5 inches

   d. The shape of the end of the electrode that is most commonly used in welding with direct current straight polarity (DCSP) is:

      _____ 1. rounded

      _____ 2. balled

      _____ 3. pointed

   e. The shape of the electrode that is most commonly used in welding with alternating current (AC) is:

      _____ 1. rounded

      _____ 2. balled

      _____ 3. pointed

6. List the types of cups or nozzles used in TIG welding.

   a.

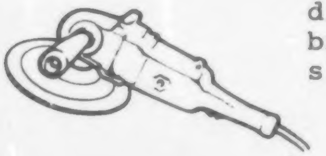
   b.

   c.

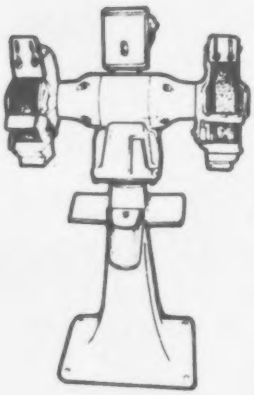
INFORMATION SHEET 18--DEFINITIONS AND IDENTIFICATION

I. Shop Equipment

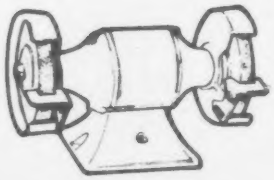
A. Hand Grinder--Portable electric grinder commonly used in the shop for rough grinding. Uses 7 and 9-inch disk grinding wheels for grinding and wire cup brushes for removal of paint, rust scale, and slag from welds.



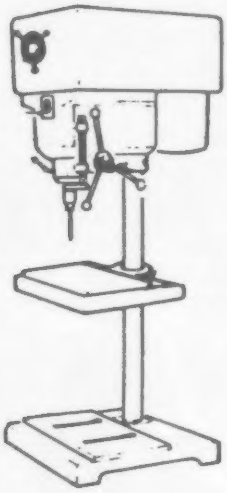
B. Pedestal Grinder--Large stationary grinder that is equipped with a base (pedestal) that is fastened to the floor. Common sizes that are ten and 12-inch models. Used for rough grinding.



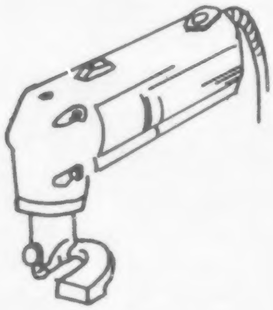
C. Bench Grinder--Smaller than the pedestal grinder and attached to a bench or table. Common sizes are the 6 and 7-inch models. Used for tool sharpening or fine grinding.



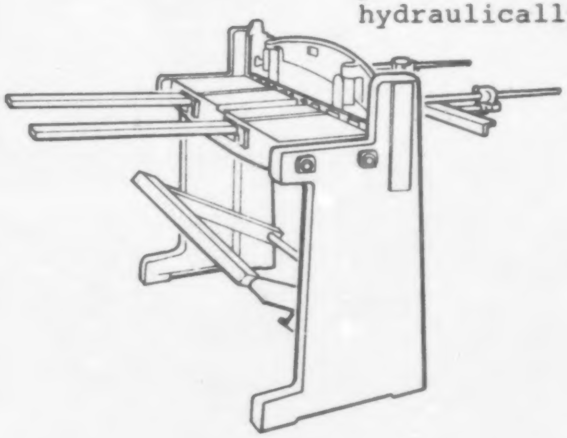
D. Drill Press--Machine tool used for drilling holes in metal. Widely used for hold-machine operations such as reaming, boring, countersinking, counterboaring, and tapping.



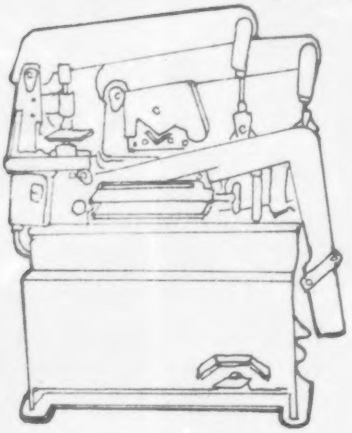
E. Portable Power Shears--Hand-held electric-powered shear used for straight or circular cutting of thin metals (gage metals).



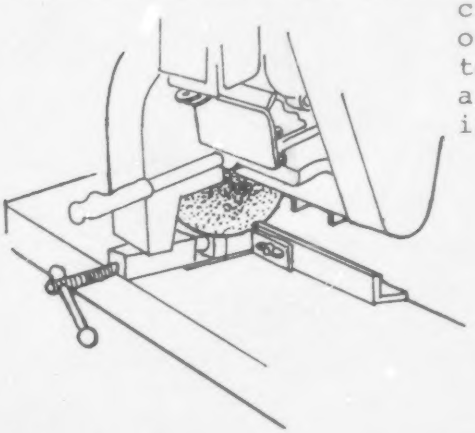
F. Squaring Shear--Stationary foot-operated shear used for squaring and trimming large sheets of metal. The maximum thickness the machine will cut is stamped on the manufacturer's specification plate on the front of the shear. May also be hydraulically or air powered.



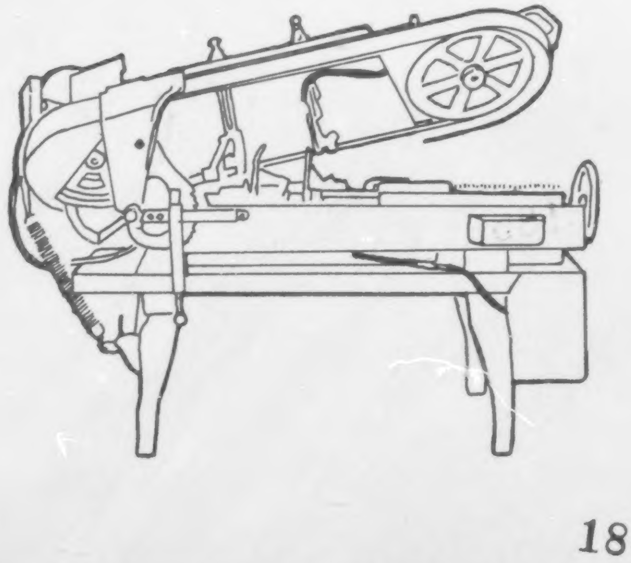
G. Ironworker--Large hydraulic-powered shear used for shearing (cutting off) flat, angle, round, square, hex, and octagon shaped metal stock to lengths. Will also punch holes and cut notches.



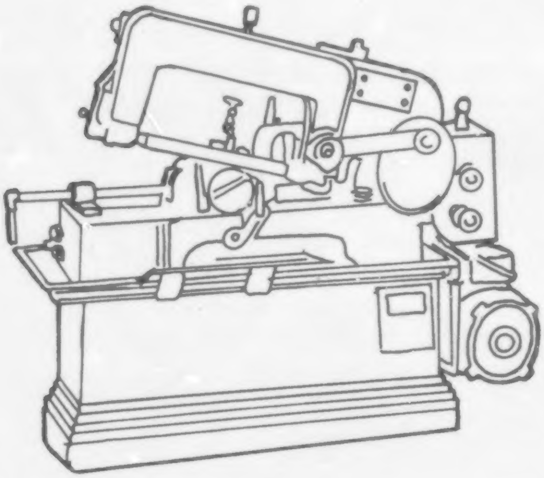
H. Abrasive Cutoff Saw--Electrically-powered saw similar to a circular saw, but cuts material by means of a rapidly revolving thin abrasive wheel to lengths. Typical sizes of cut-off disks are 10 and 14-inches in diameter and 1/8-inch thick.



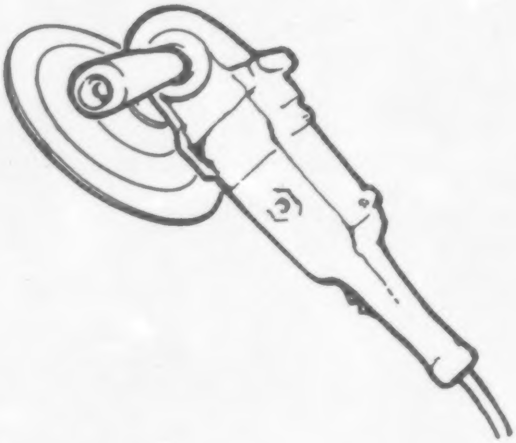
I. Band Saw--A machine tool having a continuous saw blade running on and driven by suitable pullys and used for cutting stock to length.



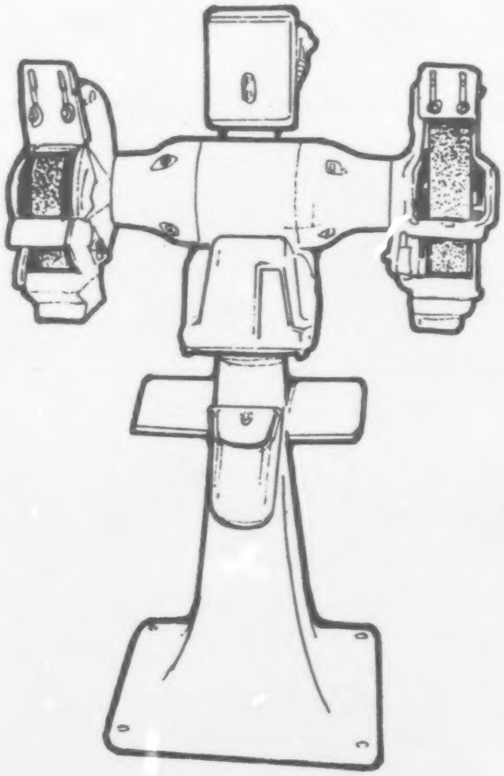
J. Power Hacksaw--A power-driven tool used for cutting off metal stock to length using a reciprocating (back and forth like a hand hacksaw) movement.



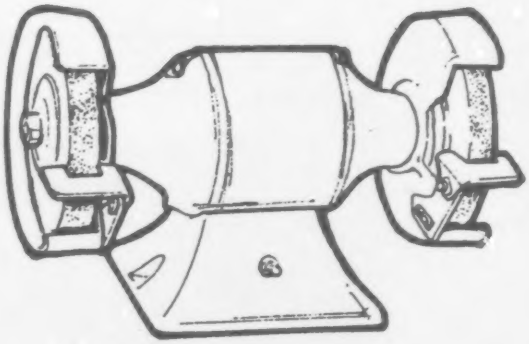
TYPES OF UTILITY GRINDERS



PORTABLE GRINDER



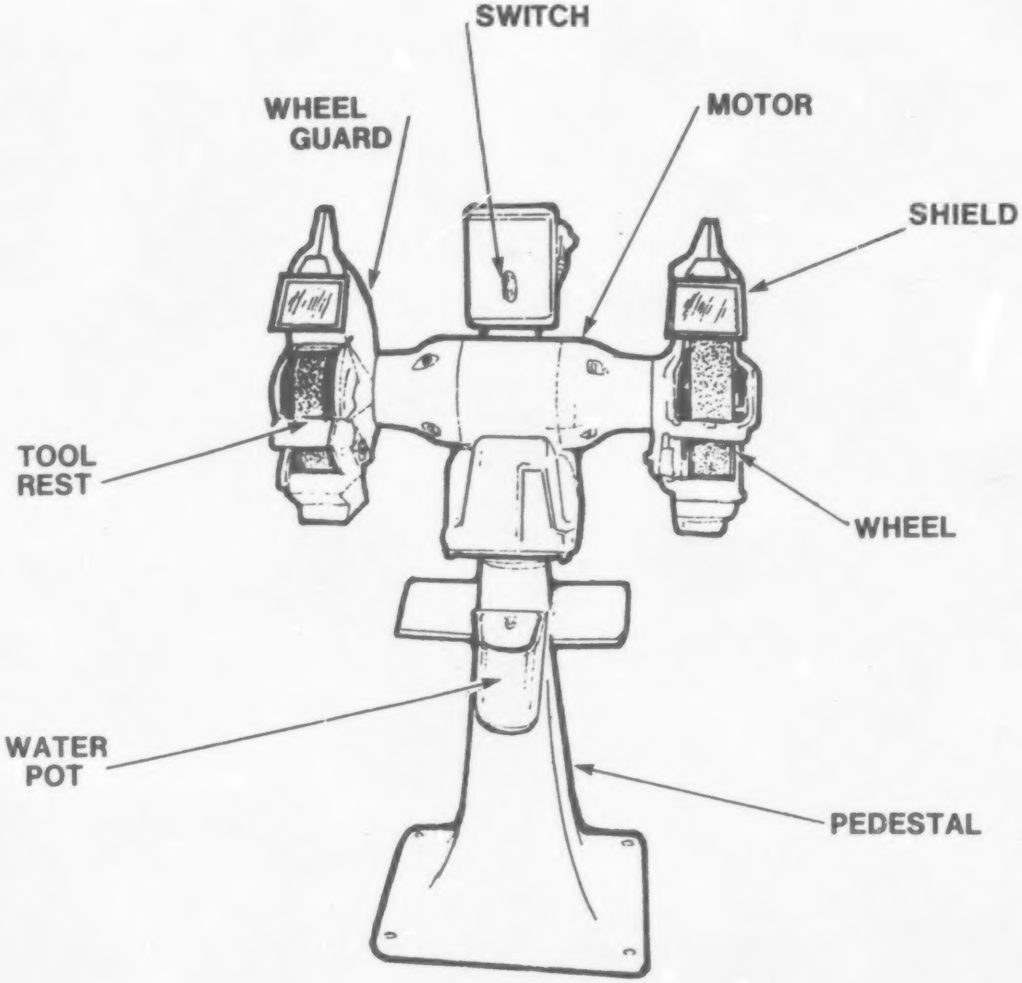
PEDESTAL GRINDER



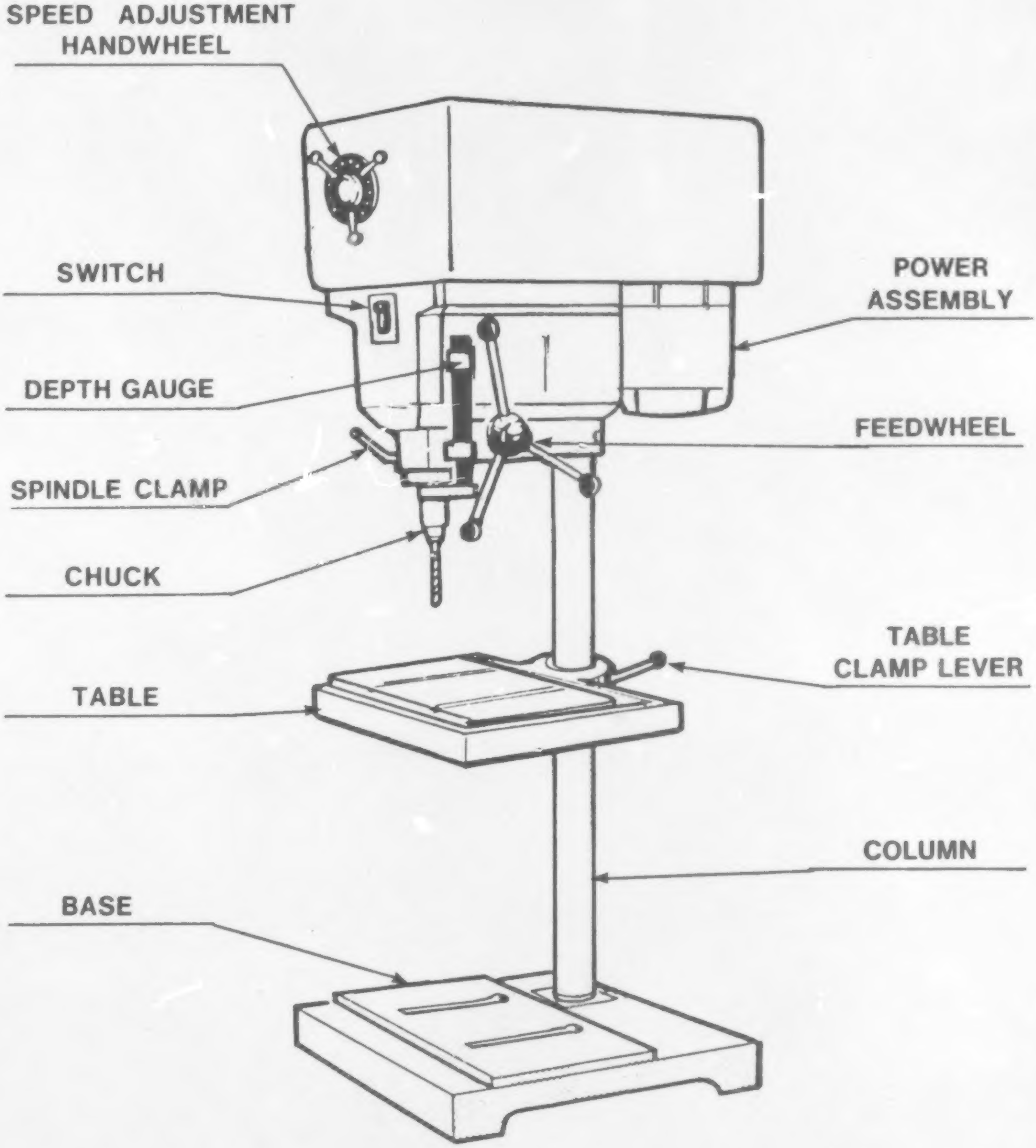
BENCH GRINDER

TM-34

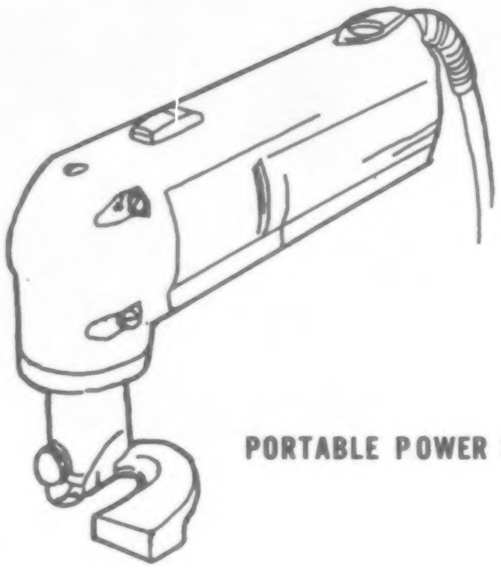
PARTS OF THE PEDESTAL GRINDER


SWITCH
WHEEL GUARD
MOTOR
SHIELD
TOOL REST
WHEEL
WATER POT
PEDESTAL

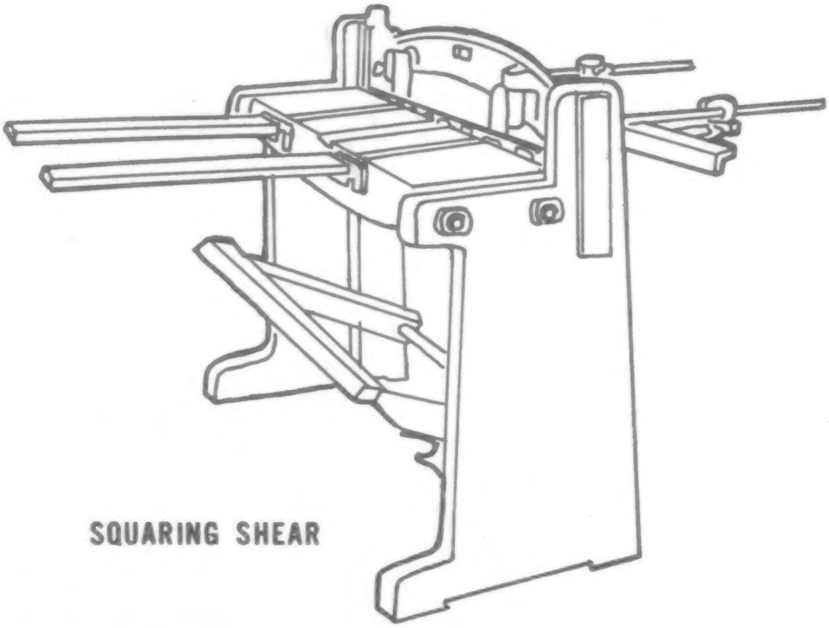
PARTS of a DRILL PRESS


SPEED ADJUSTMENT HANDWHEEL
SWITCH
POWER ASSEMBLY
DEPTH GAUGE
FEEDWHEEL
SPINDLE CLAMP
CHUCK
TABLE CLAMP LEVER
TABLE
COLUMN
BASE

TYPES OF CUTTING SHEARS

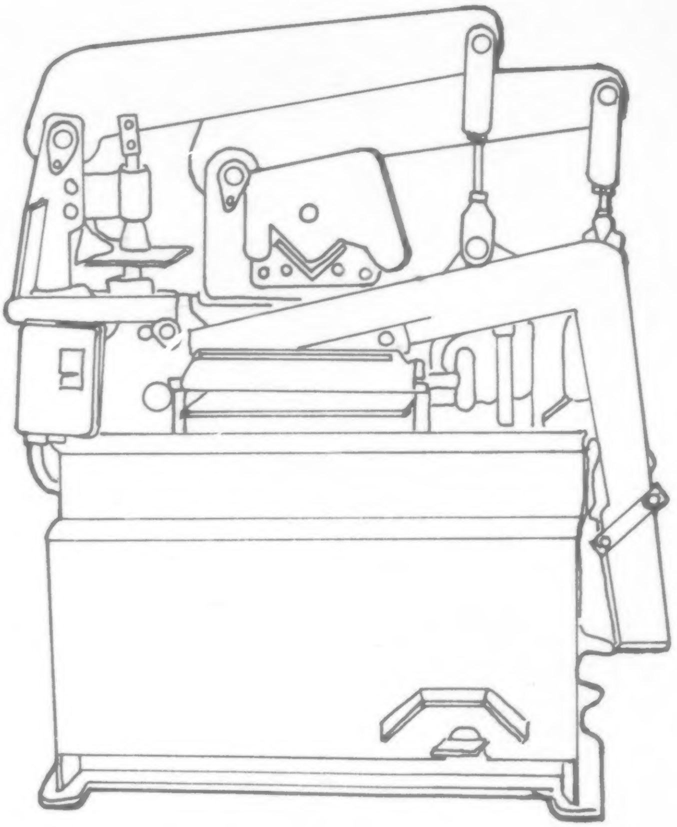


PORTABLE POWER SHEARS

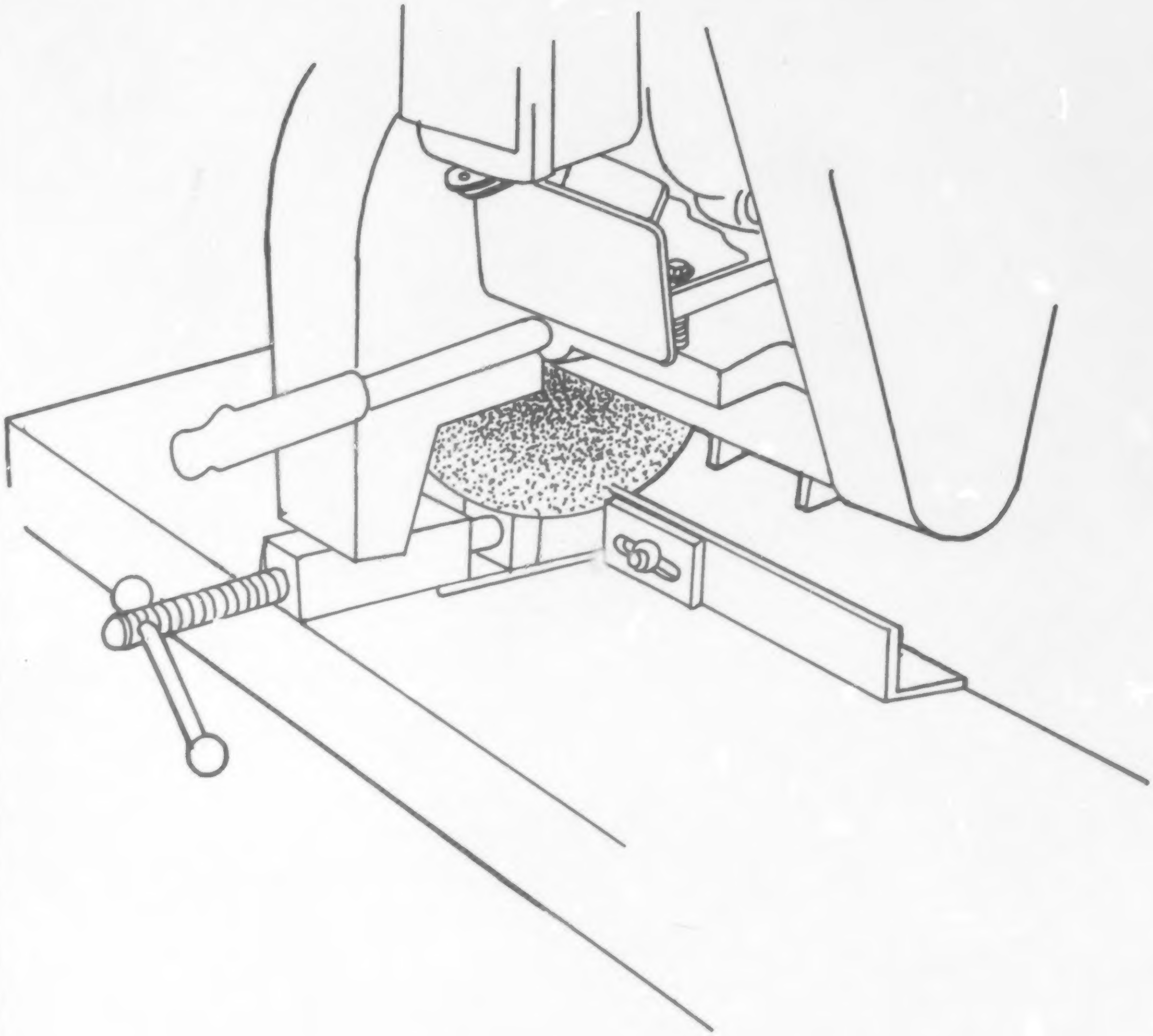


SQUARING SHEAR

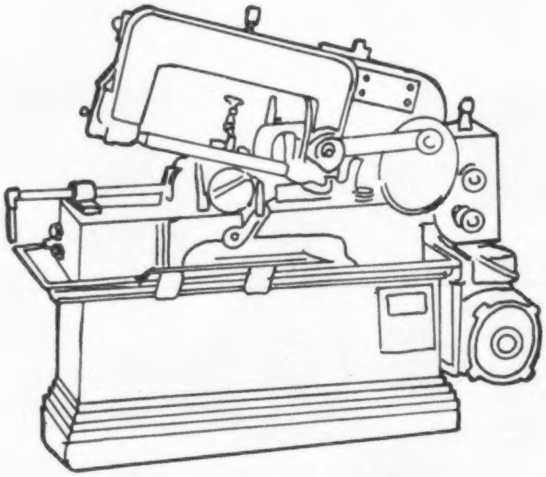
IRONWORKER



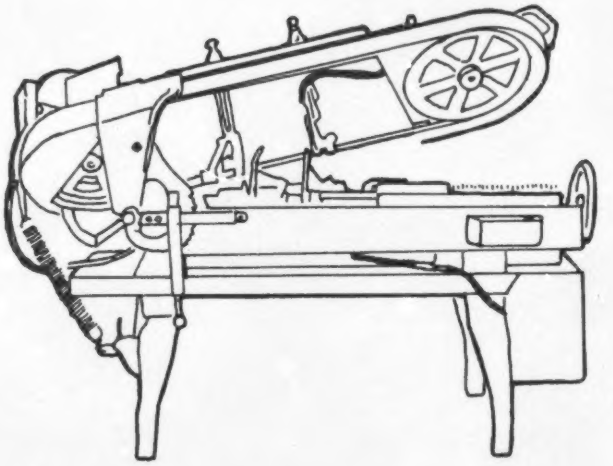
ABRASIVE CUTOFF SAW



TYPES OF POWER SAWS



POWER HACK SAW

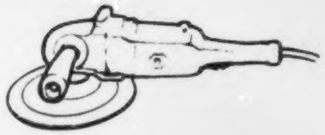


HORIZONTAL BAND SAW

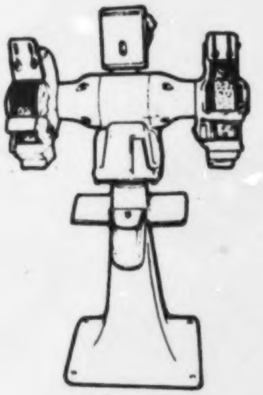
ASSIGNMENT SHEET 18--DEFINITIONS AND IDENTIFICATION

I. Directions: Name each piece of equipment and give its use.

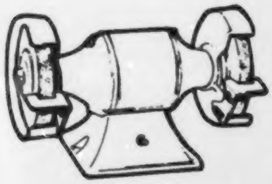
Equipment Uses



A. ____________________



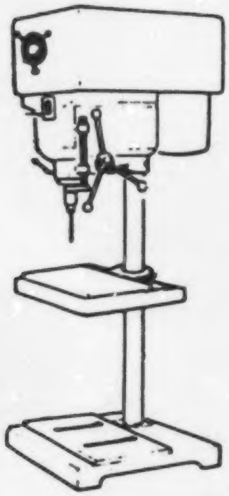
B. ____________________



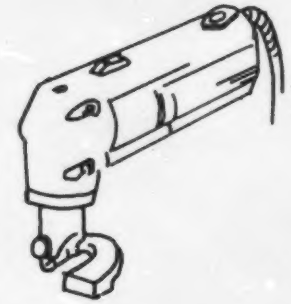
C. ____________________

Equipment

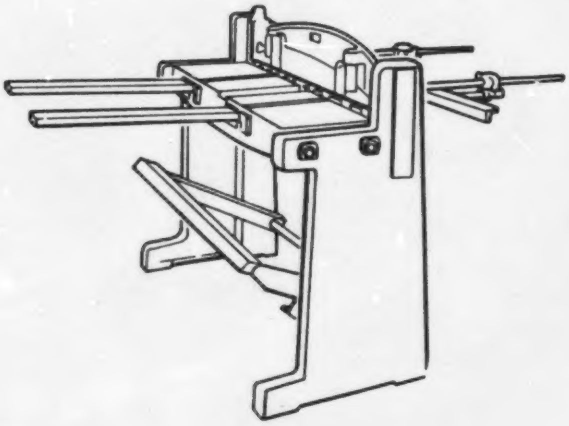
Uses



D. ____________________

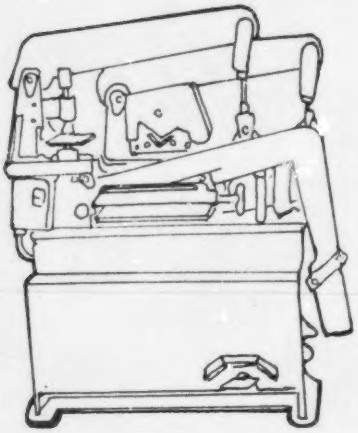


E. ____________________

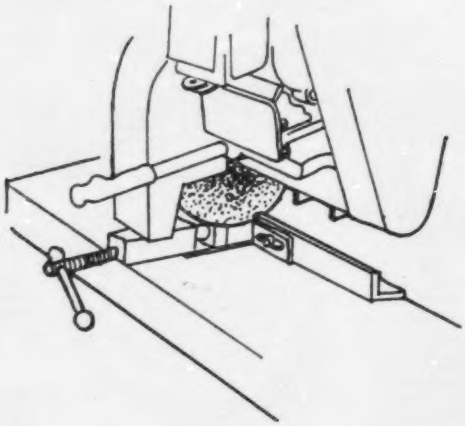


F. ____________________

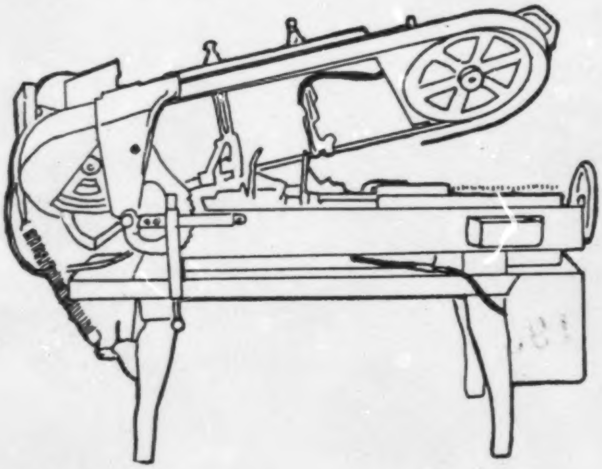
Equipment Uses



G. ____________________

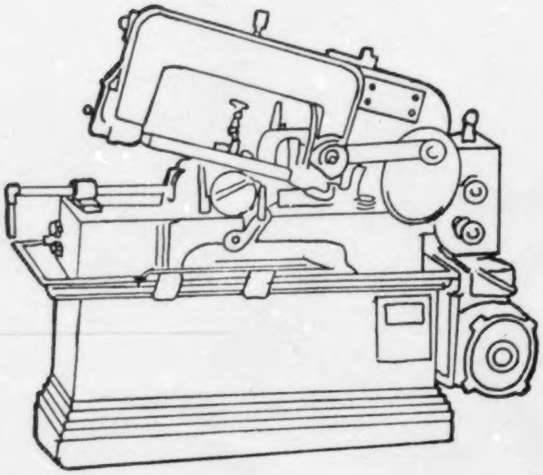


H. ____________________



I. ____________________

Equipment Uses



J. ______________________________

INFORMATION SHEET 19-SAFETY RULES AND PRACTICES

I. Safety

A. Grinders

1. Always wear goggles, safety glasses, or an eye shield when performing any grinding operation and while working in the shop.

2. Stand to the side of the grinding machine when it is first turned on and until it reaches operating speed.

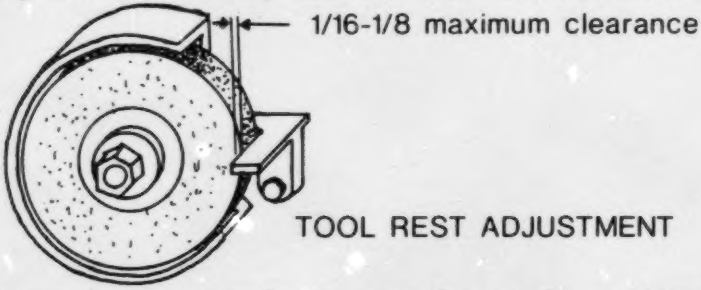
3. Never put a wheel on the grinder before checking it for cracks.

4. Keep guards and shields in place and securely fastened.

5. Keep your hands clear of the rotating grinding wheel. Hold small pieces with pliers when grinding.

6. Always stop the machine before making measurements or adjustments.

7. Make sure that the tool rest is properly adjusted. Adjust to within 1/16-1/8" of the grinding wheel.



8. Never leave a grinder running and unattended.

B. Drill Press

1. Do not operate the machine unless all guards are in place and secured.

2. Do not attempt to stop a revolving piece of stock in which the drill is caught. Turn off the power and then free the piece.

3. Relieve pressure on the drill just before it breaks through the work to prevent it from binding, causing the work to rotate or break the twist drill.

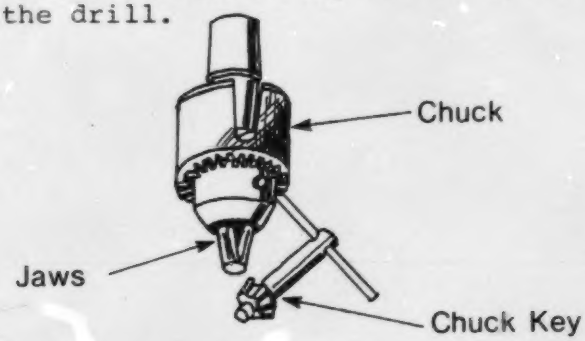
4. Clamp all work solidly with the proper device.

5. Use only straight and sharp twist drills.

6. Always stop the drill press before making adjustments or measurements.

7. Clean chips from the work and work area with a brush, not your hands.

8. Always remove the chuck key from the chuck before turning on the drill.



9. Wipe up all cutting fluid that spills on the floor. Use a piece of cotton waste or rag and be careful of chips.

10. Always wear goggles, safety glasses or an eye shield when performing any drilling operations and while working in the shop.

C. Shears

1. Always wear goggles, safety glasses or an eye shield when using a manual or power shears and while working in the shop.

2. Keep the work area clean of small pieces of metal. Place scrap pieces in the scrap box or barrel.

3. Keep fingers away from the blade on the squaring shear. All guards should be in place and secure.

4. Do not run your hands over the edge of the metal that has just been cut. Painful cuts can be received from the burrs.

5. Sheet and plate metal can cause serious cuts. Handle with care. Wear gloves whenever possible.

6. Treat every cut immediately, no matter how minor.

7. Get help when cutting large pieces of sheet and plate metal. Keep everyone clear of shear when you are making the cut.

8. Protect your feet when using the foot pedal of the squaring shear and falling pieces of metal after shearing. A serious and painful foot injury will result if one is not careful.

9. When using portable shears, keep the cord from binding or being cut by the metal edge. Do not allow heavy pieces of metal to fall on the electrical cord.

D. Ironworker

1. Keep hands and fingers clear of the blade on the ironworker.

2. Do not run your hands over the cut edge of the just-cut metal. Painful cuts can be received from the burrs. Wear gloves when possible.

3. Tend to each cut immediately, no matter how minor.

4. Get help when cutting large pieces of metal. Stand clear and alert anyone else near the cutting area when making the cut.

5. Keep the work area clean and orderly. Pick up scrap pieces and place them in the scrap barrel or box. Reusable pieces should be placed back in storage and not left laying on the floor.

6. Keep feet clear when cutting. Painful injury can occur if large pieces fall on your feet.

7. Always wear goggles, safety glasses or an eye shield when cutting and while working in the shop.

E. Power Saws

1. Make sure work is securely clamped and supported when cutting.

2. Avoid binding or placing excessive force on the cutoff wheel. It could shatter and flying parts will cause severe injury.

3. Keep guards and shields in place at all times.

4. Always be sure that the machine is stopped and power off before making measurements or adjustments.

5. Always wear goggles, safety glasses or an eye shield when cutting and while working in the shop.

6. Get help when cutting heavy material.

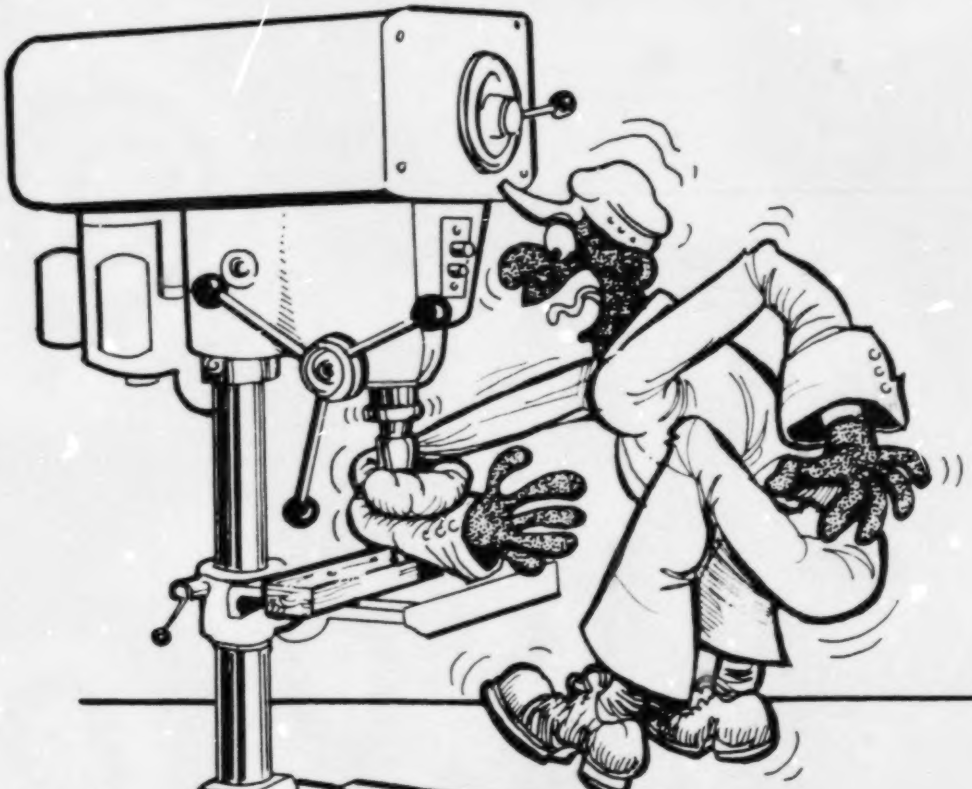
7. Keep work area free of small pieces of metal and wipe up oil and grease spilled on the floor.

8. Handle pieces of metal just cut with care. Burrs on cut pieces are very sharp and can cause painful cuts. Wear gloves when possible.

9. Do not clean chips from the machine with your hands.

10. Do not attempt to remove chips or small pieces of material while the machine is running.
11. Follow the manufacturer's instruction for tightening the band saw blade. Too much tension could shatter the blade causing particles of flying steel.
12. Keep your hands clear of moving parts.
13. Have any cuts and scratches, even though minor, treated promptly.

PROPER USE of the DRILL PRESS



ASSIGNMENT SHEET 19-SAFETY RULES AND PRACTICES

I. Safety

A. List four safety practices one should observe when using grinders.

1.

2.

3.

4.

B. List four safety practices one should observe when using the drill press.

1.

2.

3.

4.

C. List four safety practices one should observe when using shears.

1.

2.

3.

4.

D. List three safety practices one should observe when using the ironworker.

1.

2.

3.

4.

E. List five safety practices one should observe when using power saws.

1.

2.

3.

4.

5.

WELDER'S HELPER

TEST--PART 6

1. Write the correct name of the tool in the blank beside the statement that best describes the tool.

Ironworker

Hand Grinder

Drill Press

Power Hacksaw

Pedestal Grinder

Portable Power Shear

Band Saw

Bench Grinder

Abrasive Cutoff Saw

Squaring Shear

_____________ a. Portable electric grinder used for rough grinding.

_____________ b. Large stationary grinder fastened to the floor.

_____________ c. Small grinder attached to a table.

_____________ d. Machine for drilling holes in metal.

_____________ e. Hand-held shear for cutting thin metal.

_____________ f. Foot-operated shear for cutting large sheets of metal.

_____________ g. Large hydraulic shear for shearing common shapes of metals such as: flat, angle, round, and square.

_____________ h. Power saw that cuts materils by means of a rapidly revolving thin abrasive wheel.

_____________ i. A machine tool having a continuous saw blade.

_____________ j. A power-driven tool for cutting metal stock using a reciprocating (back and forth) movement.

WELDER'S HELPER

2. Point out the parts of the pedestal grinder by writing the name of each part listed below in the correct blank in the illustation

Wheel

Wheel Guard

Motor

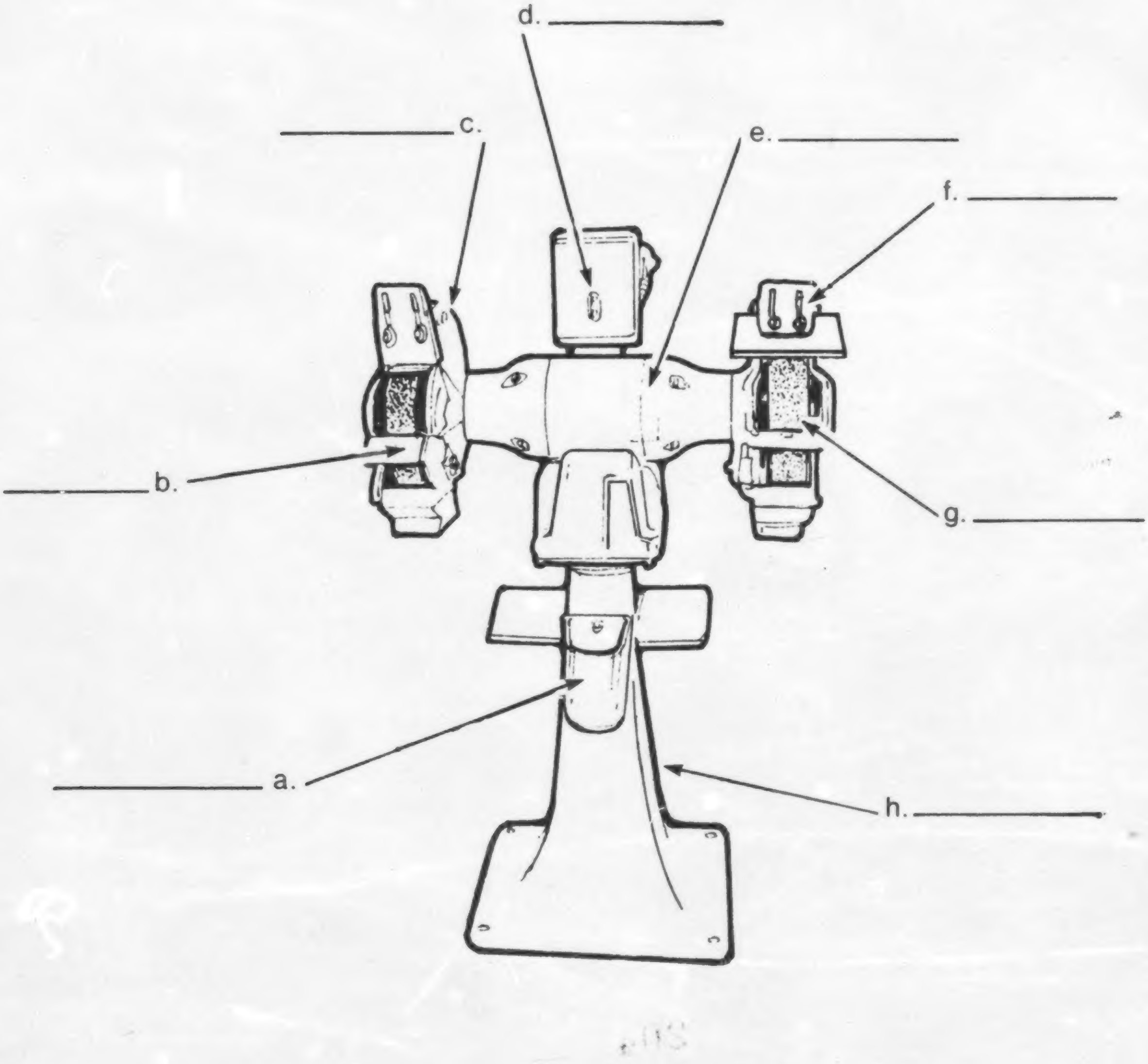
Tool Rest

Switch

Shield

Water Pot

Pedestal



3. Identify the parts of a drill press by labeling the illustration below.

Chuck

Base

Table clamp lever

Column

Power assembly

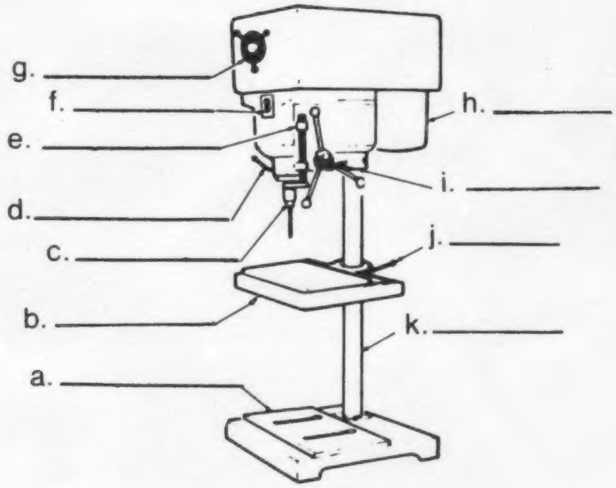
Switch

Speed adjustment handwheel

Depth gauge

Spindle lock clamp

Table



WELDER'S HELPER

4. Answer the following statements about safety by writing TRUE or FALSE in the blanks at the left.

_____ a. Always wear goggles, safety glasses or an eye shield when performing any grinding, cutting or shearing operation.

_____ b. Adjustments and measurement can be made while power machines are running.

_____ c. Keep the chuck key in the chuck of the drill press at all times.

_____ d. Wipe up all cutting fluids that spills on the floor.

_____ e. Clean chips from the work area with a brush, not your hands.

_____ f. To test the cut, run your hands along the cut and check for squareness.

_____ g. Treat every cut immediately, no matter how minor.

_____ h. Remove shields and guards when doing heavy grinding to allow excessive chips to fall onto the floor.

_____ i. Follow the manufacturer's instruction for tightening the band saw blade.

_____ j. Do not attempt to stop a revolving piece of stock in which the drill is caught.